THE

ELECTRICAL REVIEW.

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ELECTRICAL REVIEW.

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SMALL ELECTRICAL EXHIBITIONS.

ALTHOUGH we fully recognise that publicity literature, properly prepared, has its place to fill in the important work of popularising electricity for lighting, heating and power purposes, we have not hesitated to express the conviction that this department of effort is, and can only be, subsidiary, auxiliary or supplementary to the general scheme of commercial development. We believe that recent experience has shown that small local exhibitions are invaluable for arousing and stimulating electrical interest among ratepayers and residents; it may be that publicity literature can be profitably utilised in working up interest to a point inclining the public to attend an exhibition, though we think the fact that there is an exhibition within easy reach will act as a magnet by itself. The literature may serve a useful purpose in fostering the electrical desire or habit in the almost-persuaded after the exhibition has been visited. Be this as it may, we believe that the local electrical exhibition is an effort which soon fully repays the supply authorities for the trouble and expense involved, and it is not rendered less necessary by the existence of permanent showrooms such as some we have in mind—electrical exhibitions in miniature, may we call them? The holding of a special exhibition, either by one authority or jointly by several, implies a drum-beating summons and a special complementary effort for bringing the people intimately into touch with the concern from which their own or contiguous districts derive their electricity; and often at such times there is an earnest, concentrated effort in a comparatively small area which is more distinctly felt than when we hold a big exhibition for the whole of a large area like London, and only approach the general populace in a scattered or half-hearted way. At the big exhibition—whether purely electrical, as at Manchester and Olympia, or mainly general with a slight electrical character, as at Brussels, Paris, Turin—there are so many things of other kinds attracting attention that, from the electricity supply station point of view, the needs are not met, however satisfactory they may be in business done by the industrial manufacturer. Such exhibitions undoubtedly do a world of good in their own particular sphere, but the local electrical exhibition is promoted purely and solely for interesting and educating the public regarding the practical applications of electricity and the devices by which these are performed. The travelling-exhibition idea, started some years ago by Edmundson's Electricity Supply Corporation, for visiting the various small localities in which that company had supply powers, formed a very worthy attempt, and is deserving of emulation, if the cost of a special local show is considered too great. It has been suggested to us that, as a means of pushing the business, arrangements should be

made on a comprehensive scale for organising a complete system of educational exhibitions under the management of experienced experts. It might be undertaken by an independent company, arranging with the various electrical undertakings throughout the country to establish exhibitions for a week or two, accompanied by popular lecturers and demonstrators, charging a fixed fee, or, if charges for admission were made, sharing the profits.

An exhibition of the kind we suggest was held in one of the metropolitan suburbs about 10 years ago, in connection with an electric lighting station then newly established, and proved to be very successful in promoting the business. The room in which it was held was in a large private house and about 100 people attended by invitations sent to residents on the route of the mains. On the platforma selection of domestic appliances was arranged consisting of kettles, saucepans, flat-irons, ventilators, and small motors for sewing machines, &c. The room being, of course, lighted by lamps in various styles of fittings—all supplied by one of the local firms, free of expense, for the purposes of advertisement.

The lecture delivered was of a thoroughly popular character—illustrated by a cooking demonstration undertaken by the servants belonging to the house, who had acquired the necessary skill—and an excellent dish of cutlets, mashed potatoes and tomato sauce, was cooked to perfection in presence of the audience and pronounced to be perfect. Tea and coffee, with toast and cakes, followed, the lecturer finally ironing the pocket handkerchiefs of the ladies. The ventilator on the platform was worked to show the action of the motor and the success in ventilating the room.

Exhibitions of this character, given at intervals of a few months, would, it is thought, be of great practical value in educating the public to the use of electricity for domestic purposes, and tend to increase rapidly the number of consumers.

At the recent exhibition at Olympia, nothing interested the general public more than the cooking demonstrations, the suites of rooms fitted with electric radiators, the ozone ventilators, and various domestic appliances.

In addition to the local exhibitions, the public might be invited to inspect the stations and see the machinery in operation, or, if the necessary accommodation is available, hold the Exhibition and have the explanatory lecture delivered at the works, in which case the expenses could be reduced; but this would only be practicable where a suitable room was available away from the noise of the moving machinery, or in stations where the energy was taken in bulk and not generated on the spot.

Of course, as we have said, these exhibitions should only constitute one element in the general business-getting arrangements.

Everybody must admit that, notwithstanding the developments in the use of electricity, there is still a great deal of spadework to be done, even in towns where supply works have been in operation for many years.

Where the mains have been laid for 10 or 12 years, the proportion of those who are receiving a supply of electricity to the number of residents thereon is very small, and this seems to prove that the means employed for obtaining consumers are not perfect.

Those who have had considerable experience in organising the business in many towns know that the ordinary canvasser, however eloquently he may describe the advantages of adopting electric light or power, is constantly met with the reply, "*I will consult some of my neighbours who have tried it.*" This points to the necessity of obtaining and publishing local testimonials, which are far more effective than any other kind of literature.

When the customers have been secured and become familiar with the use of electricity for lighting, they will be interested in receiving the manufacturers' price lists and leaflets offering appliances for other uses, such as cooking, heating, ventilating and power for a variety of domestic purposes, which are of no use until the preliminary result has been obtained of connecting the customer with the mains.

It is satisfactory to find that the supply of small houses is being profitably undertaken on terms which prove that Sir Wm. Preece's old description of electricity as "the poor man's light" has to-day become true. The experiment by the Corporation of Eccles is a case in point, rows of small cottages being supplied each with four suitable lamps to light that number of rooms at a charge to the occupiers of 6d. per week, which more than covers the cost. This is accomplished by one connection with the mains, the wiring being run through the row of cottages.

At Sydenham a row of 16 large houses, each containing two modern flats, built on a road running at right angles to that in which the electric mains are laid, are supplied by a similar connection, so that this by-street is served without the cost of laying a main. This arrangement points to a considerable saving in capital outlay, and is, we believe, already adopted in many places, the wiring being carried in some cases externally and in others internally from house to house, as at Sydenham.

In one town within our knowledge, 40 workmen's cottages are supplied from one service connection with the mains, at a cost of 3d. per unit, which realises a substantial profit to the company.

To our mind, the time is fully ripe for launching out on a far bolder electricity supply business-getting enterprise in most parts of the country, and particularly in the metropolitan area. The reports that reach us from time to time from different directions make us ashamed of some of those who ought to be leaving no stone unturned to replace gas by electricity.

Memorandum on Steam Boilers.

A very excellent White Paper has recently been issued by His Majesty's Stationery Office, upon steam boilers. If not particularly original, it has the advantage of being made up from information derived from the best sources. It is designed for the use of those in charge of steam boilers.

Steam users are specially reminded that they are responsible for their selection of the competent person whom they require to undertake the periodical statutory examination of steam boilers. We always regarded it as a somewhat meddlesome interference on the part of the Board of Trade when it instituted supervision over steam boilers by itself, a Government department. The early reports of the Board's inspectors were very farcical indeed, and later legislation, of the kind which makes a householder into his own tax-gatherer, has thrown on a boiler owner the incubus of selecting competent persons. The very wording of the Act is ridiculous, and has resulted in the handing over of boiler inspection to very incompetent persons, for the Act does not suggest that a competent person shall have any experience in boilers. Now, before the Act a boiler owner would have been responsible for the results of his neglect. To-day he may escape behind his belief that he did select a "competent person." The author of this White Paper appears to us to be better than the Act, for he recommends insurance as the best course to adopt. A series of nearly a score of lithographed sheets of details of dangerous faults of combustion, samples of corrosion, of settings and setting blocks, and leakage packings, will prove useful. At one time, we believe, the Board of Trade decreed safety-valve areas solely on boiler grate surface, irrespective of pressure, and this, of course, gave very excessive valve sizes in high-pressure boilers. The Table 8 in this memorandum is evidence that this error has been amended. Practically all the good points in this paper have been evolved in the course of boiler-insurance experience. With a body of specialists constantly observing the action of steam boilers all over the country, and their observations being all focused at one head office, the occurrence of a particular defect was soon found to be accompanied by a definite environment. Cause and effect in engineering matters can only be very surely determined as parent and child by a sufficient number of occurrences to carry the coincidence into conviction; and it has been this correlation which has elevated boiler engineering from its crude state of 1854 to the high position it occupies to-day. Change has been steady, if slow, and often

has been delayed by the boilermakers themselves, who at one time rather tended to resent the interference of the insurance companies.

According to this paper, the proportion of Lancashire and other cylindrical boilers is about 10 to 1 water-tube boiler. The ratio of explosions is less than two to one. This shows that the shell boiler is by far the safer boiler. But the worst boiler is the horizontal multitubular, with a number ratio of about 1·06 and an explosion ratio of over 2·5. It is four times as dangerous as the water-tube boiler, and 24 times as dangerous as the large shell boiler. It is computed that there are 150,000 to 200,000 boilers in use on land in the United Kingdom.

No reference is made to the method of preventing end-plate grooving by the use of slotted rivet holes—a new method well worthy of careful note.

It is to be noted that the unstayed ends of thermal storage drums—and, we may suppose incidentally, of water-tube boilers—should be carefully examined. This appears to be a certificate of safety for these unstayed ends, but we are strongly of opinion that such ends ought to have a central stout bolt stay between them. Dished ends are not hemispheres, or they might be trusted to look after themselves. A dished end is always on the move, breathing with every change of pressure and trying to produce grooving. This point was enforced by boiler experts at the time of the Greenwich explosion several years ago.

Lightning and Electricity Supply.

It is a curious fact that the greatest enemy to the transmission of electricity over considerable distances should prove to be of its own kin—the oldest known form of electrical phenomena warring with the newest developments of electrical science. It is true that in this country little trouble is experienced from this cause, our most violent "thunderstorms" being comparatively tame compared with those which occur abroad; but, on the other hand, we have no use at present for long transmissions, and owing to the special conditions obtaining in this densely-populated country, we are often compelled to lay our cables underground, where they are practically immune from lightning troubles.

Another singular feature of the situation is the fact that the greatest difficulties are met with where pressures of the order of 50,000 volts or less are employed; at the higher pressures such as 80,000 and 110,000 volts, which are now coming into use—pressures which ten years ago would have been regarded as wholly impracticable—the trouble is to a great extent alleviated, mainly on account of the extremely good insulation necessary to control such high voltages, which at the same time provides an effective safeguard against lightning discharges.

Probably there is no part of the world where greater difficulties have been experienced from atmospheric electricity than the Witwatersrand; within a remarkably short space of time the utilisation of electric power has there attained to extraordinary dimensions, and electricity has become practically indispensable to the economical operation of the gold-mining industry. It naturally follows, therefore, that the phenomena connected with atmospheric electricity have demanded and received the closest attention on the part of the engineers responsible for the transmission lines, and their experience in this subject is probably unique. We print elsewhere in this issue an abstract of an interesting paper read before the South African Institute of Electrical Engineers by Mr. Adendorff, describing the conditions prevailing in the Rand and the precautions observed. Apparently the most effective safeguard against lightning discharges is the simple one of shielding each cable throughout its length by an earthed wire suspended above it, and in spite of its costly nature, the author declares that this is well worth the necessary expenditure. But experience on the Pacific Coast has not been favourable to the ground wire, and there are other dangers against which this device is of little effect, such as the surges set up in the line by sudden changes in its electrical condition through the occurrence of a short or an open circuit; there is very much still to be done before these can be wholly overcome.

NEARLY A SHUT-DOWN.

[COMMUNICATED.]

Central station engineers have often to be thankful that incidents through which they have passed, have been only nearly, and not quite, a breakdown. Probably the majority of charge engineers can relate more than one anecdote of occurrences which were for a moment or two touch and go, but which were fortunately saved from becoming a serious matter. One such incident is of interest, as it points out the value of having, if possible, a fairly good reserve of power in the exciting set of an alternating-current station. In the case considered the station included not only some high-speed generators, but also one or two low-speed machines driven by horizontal cross-compound engines. The whole plant was alternating current, and the excitation for the generator fields was taken from a common bus-bar supplied from one or other of two duplicate direct-current steam-driven exciting sets. These two sets were controlled from the same switchboard as the main generators having exciter panels containing their main switches, rheostats, fuses, and also the shunt field switch.

The exciters were compound wound, and were frequently subjected to considerable overload especially when towards evening the lighting peak came on the station. At one time some extensions were going on involving a little reconstruction work on the switchboard, and, although it was hardly an advisable procedure, the work was carried on at all available hours, and part of this work had to be done behind the switchboard, care being taken to prevent as far as possible anyone but skilled men from going behind. One evening, however, just as the lighting peak was on the station a sharp flash was noticed behind the board, and immediately the station lights began to drop in brilliance. These were fed from a transformer connected to the main supply, so that attention was immediately directed to the main voltmeter, and to the consternation of the engineer in charge it was seen that the supply voltage was also falling. One of the drivers who was near the exciters at the time, shouted out to the engineer, and it was seen that the brushes on the exciter commutator were sparking violently. The engineer at once jumped to the conclusion that something was wrong with the exciter, and he signalled for the second set (which was always kept turning slowly when peak loads were on the station) to be run up immediately, and made all preparations to get the second machine in by switching on the field. At the same time, it was noticed that the ammeter needles on the alternators began to swing violently, and by the grunting which went on in the machines it was evident that heavy cross currents were surging between the machines, tending to throw them out of step. The situation was therefore at this point very critical. Before, however, the incoming exciter could be brought up to the working pressure, owing to the time taken to build up its shunt field, the danger symptoms appeared to be slightly alleviated. The voltage of the working exciter, which had begun to drop, appeared stationary at about 10 per cent. under its normal value, and then the needle began to move slowly upward again. At the same time the station lights grew brighter, and gradually everything resumed its normal state. The surging between the alternators ceased, and although, as a precautionary measure, the exciters were changed over, it was afterwards found that even this was really unnecessary.

The clue to the whole affair was given by a rather scared workman who emerged from the back of the board, and who, after some little questioning, admitted that he was responsible for the occurrence. It seems that in working on an adjacent board, which was rather close to the working exciter panel, he had accidentally knocked against the moving contact of the shunt, which was operated by a hand-wheel from the front of the board, and it had gone right back on to the open-circuit stop. He had immediately snatched off his cap and gripped the switch contact, twisting it back again into place, but although he showed great presence of mind in doing so, he was not quite quick enough to prevent the magnetisation of the shunt field from falling, and thus for a very short time the working exciter was dependent upon its series field for all the magnetisation it possessed. There was, therefore, a struggle between the armature reaction in the

exciter and the demagnetising action of the series windings until the shunt field was able to build up again to its proper strength, and while this lasted it was touch and go whether the exciter would lose its magnetism altogether, or could build it up again under the conditions of loading. It was very fortunate for the station supply that the field remaining was strong enough to overcome the demagnetising effect of the armature current.

At it happened, no one was hurt over the matter, but the incident is interesting as pointing out the advantages of a good stiff field on the exciter, in order to cope with unexpected affairs of this sort. Had the exciter been simply a shunt-wound machine, there would have been no hope at all. Another lesson which was derived from the occurrence was not to allow projecting portions of the switchgear, even at the back of the board, to remain exposed without some form of guard in any position where men passing along the back of the board, or working thereon, could come into contact with them.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

The Institution of Electrical Engineers.

May I beg the hospitality of your columns to express my entire agreement with Mr. Sankey's letter of last week's issue? Personally, I have no objection to paying an increased subscription, even in my class (student), if it is "for the good of the hive"; but is it?

I note Mr. Sankey says "some attempt should be made to get a minimum salary basis, especially for central station posts." This point should be the fulcrum about which any movement to improve the status of electrical engineers must turn. Surely it is not possible for a profession to stand high when its members—even those with technical college training and practical experience—are paid 25s. a week (ELECTRICAL REVIEW advertisement). Married electrical engineers are to be found, all over the British Isles, filling responsible positions, and living in the abject poverty which 50s. a week entails.

Truly, electrical engineering is a dog with a very dirty tail, and it behoves the Institution to set to work and remedy this defect; if possible, without amputation. As regards the new class, I, for one, strongly object to the transference of the "student," or the admission of the new member without some examination and an approved course of training, either in a technical college or works. The period spent in the works might be made shorter for the college student; a preference might also be made in favour of those who had been through the "student" class; but, in any case, evidence of examination should be made compulsory for the junior class, not for the Associate membership.

Surely the Institution need not fear the taint of trade unionism when the House of Commons has condescended to dabble in domestic finance.

George E. Graham
(*Student, I.E.E.*).

Merrion, *December 20th*, 1911.

P.S.—I am sure that many other juniors will join me in thanking Mr. Sankey for his letter. It is a great thing that a man of his position should have given us a lead.

Post Office Telephone Charges.

I enclose a notice received from the general manager of the London telephone service in reference to my private telephone, which I think is rather instructive. If this is an indication of the trend of events under the State control, and a foretaste of what we may expect in the future, I think the outlook is anything but encouraging. By my existing contract with the Post Office, which does not expire till April, I pay £5 per year, and 30s. *in advance* to cover the cost of any calls I may have. This never proves to be sufficient, and I am constantly sending them amounts for the excess above the deposited minimum, after the date, of course, when this minimum has been exhausted in calls. Now they ask me to send, *by return of post*, a further 15s. on account of any such excess as may in the future occur. Personally, I hold that until my existing contract expires they have no right to alter the conditions of same; but whatever the legal aspect of the case may be, I think the policy involved in such a demand is vexatious.

Thos. Browett.

Westminster, *December 19th*, 1911.

LEGAL.

JENKINS *v.* THE EMPIRE ABERDARE, LTD.

IN the Chancery Division, Mr. Justice Neville had before him, on Wednesday and Thursday (December 20th and 21st), this action, by which the plaintiffs, as trustees of Trinity Chapel and schools, Aberdare, sought an injunction and other relief in respect of an alleged nuisance of noise and vibration caused by machinery for lighting electrically the defendants' music hall. Mr. Jenkins, K.C., and Mr. Adams, were counsel for the plaintiffs, and Mr. Peterson, K.C., and Mr. Simmonds for the defendants.

MR. JENKINS explained that the buildings in respect of which the plaintiffs sued belonged to the Calvanistic Methodist Connection, and consisted of a chapel, schoolroom, lecture room, classrooms and minister's room. The defendants' building was at the rear of the chapel, and to some extent ran by the side of the other buildings. Between was a yard, and before the commencement of the action, in that yard the defendants had a gas engine, which was used for the purpose of supplying power for generating electricity for lighting the theatre. This the plaintiffs contended caused an actionable nuisance. The gas engine, however, was removed in May last, about two months before the action was commenced, and when the local Council obtained powers for supplying electricity, instead of taking their electricity for lighting direct from the Council, which would have caused no nuisance, the defendants took electricity for the purpose of supplying power to a motor which they had erected in the place of the old gas engine, and from that they lighted their music hall. This motor when running, it was alleged, caused a whistling and humming noise which seriously interfered with the use of the plaintiffs' buildings, and further there was sufficient vibration to cause the windows of the room to rattle. Evidence was called in support of the plaintiffs' case, which was not concluded when the Court rose for the Christmas vacation, and the further hearing was adjourned until January 11th next.

A FIFE TRAMWAY CLAIM.

SHERIFF MORISON has affirmed, on appeal, the judgment in the action raised by a butcher against the Wemyss and District Tramway Co. He sued for £300 in respect of damages sustained by him through being run down by one of the defenders' cars. The damages were assessed at £112.

Liverpool Electricity Supply.—The Corporation had before it on December 20th the report of the Electricity Committee, recommending, on the advice of the consulting electrical engineer, the replacing of the old engines at the Lister Drive station with new turbines, at a cost of £40,000. The following tenders in connection therewith were submitted for acceptance:—British Westinghouse Co., two 2,000-KW. direct-current turbo-generators, with accessories; British Thomson-Houston Co., two 3,500-KW. turbo-alternators, complete with circulating water pipes and accessories, and for the purchase and removal of existing plant; and the Worthington Pump Co., four cooling towers and pipes. Sir Chas. Petrie (chairman of the Committee), in supporting the recommendations, said, in regard to this particular machinery, that it did not refer in any way to the turbines that were put in Lister Drive station five years ago. Aspersions had been made, and innuendoes cast, that these turbines were the plant they wished to get rid of. The machinery to be replaced had been working for 12 to 13 years at Lister Drive, and had paid very well for itself. There would be some additional expenditure in connection with the £40,348 required for the plant, such as the foundations of cooling towers, &c., so that some £52,000 would probably be required. It was true economy to substitute up-to-date machinery, and in that spirit the resolution was brought forward. An amendment was moved to refer the matter back to the Committee, with instructions to obtain the best expert advice available on the position of the electrical undertaking. Alderman Sir Wm. Bowring, in submitting this amendment, argued that the public's suspicion had been aroused by the hurry with which the Committee had brought the scheme forward, involving serious cost, and possibly a considerable departure in new experimental developments. An animated debate followed, in which it was pointed out that so long ago as January 6th, Mr. Bromley Holmes (consulting engineer) reported to the Council upon the needs of the generating station. The amendment was defeated by a large majority, and the Committee's recommendation was approved.

THE FORMATION OF DEPOSIT BY TRANSFORMER OILS.

By HAROLD D. SYMONS, A.M.I.E.E.

(*Concluded from page* 1040.)

Test 2.—*Heating for one Hour at* 200° *C.*—This test will at once determine whether an oil will form deposit readily, for, should there be any formed during the test, such an oil will form deposit readily at lower temperatures. It is necessary to examine carefully after test, as in some cases the deposit is of such a fine nature that it will remain in suspension in the oil for some while. The sample should not be examined less than 24 hours after test. Some discoloration takes place, but the change with a good oil, though marked, does not destroy its brilliancy. A pale yellow oil with a flash point of 170° C. will turn a dark red colour, and lose from 7 per cent. to 8 per cent. in weight. The loss in weight with oils of different flash points will vary considerably; the lower the flash point the higher the loss. The marked discoloration and loss in weight is accompanied by a thickening of the oil. In cases where the per cent. loss in weight is high, this thickening may be considerable, particularly if the oil will form deposit, but not very readily.

Test 3.—*Heating for Six Hours at* 10 *per cent. (in degrees C.) above flash point.*—As an example of 10 per cent. above flash point, an oil with a flash point of 150° C. would be heated at 165° C. This test is not so severe on pure oils with a flash point lower than 165° C., as Test No. 4, but is nevertheless a severe test; in fact, one that very few oils will withstand without forming deposit.

For the oils having a flash point higher than about 165° C., this test is rather more severe than Test No. 4, and any oils that do not form the least trace of deposit during this test will be immune from its formation during service. The discoloration is considerable, and the thickening marked, whilst the loss in weight is high. The higher the flash point the lower the loss in weight, but a more marked thickening of the oil generally takes place. No examination for the formation of deposit should be made within at least 24 hours after the test.

Test 4.—*Heating for Four Hours at* 200° *C.*—This is the most severe test that can be applied to oils having a flash point below 165° C., and any that will withstand this test without forming the least trace of deposit will be free from its formation in service. Naturally, considerable discolouration, very marked thickening, and a great loss in weight, takes place, and few oils will withstand the test without forming deposit.

Every transformer oil should be submitted to Test No. 2, and if it passes this without the formation of deposit, Tests 3 and 4 should then be made.

The heated samples should be retained and examined. Comparison should be made with a sample of the original oil, to judge of the discoloration, and, if possible, with other oils that have been submitted to similar tests.

Any comparison should always be made in a perfectly clean vessel, of the same shape and dimensions, and containing approximately the same volume of oil.

For commercial purposes, the examination and comparison of the sample submitted to heating tests will be sufficient to indicate an oil that will not form deposit in service.

The discoloration should be judged against a white background. An oil that will form no trace of deposit, and is not rendered very dark and murky by Tests 3 and 4, will be free from the formation of deposit in service.

In cases where deposit is formed, it is small in volume and difficult to free from the oil. It is almost impossible to obtain accurate measurement of the quantity, but since its formation condemns the oil for the purpose in view, there is no particular object in doing so.

The discoloration during Tests 3 and 4 is generally accompanied by a marked change in odour, which should also be noted.

Whilst the comparison of samples is a convenient method of selecting an oil that will be free from the formation of deposit, it necessitates retaining a number of samples. These tend to deteriorate with age, and the personal element then becomes even a greater factor in the judgment by comparison. A series of experiments were, therefore, undertaken on samples of heated oils, with a view to ascertaining whether there was a relationship between any physical or chemical change other than discoloration, and freedom from deposit.

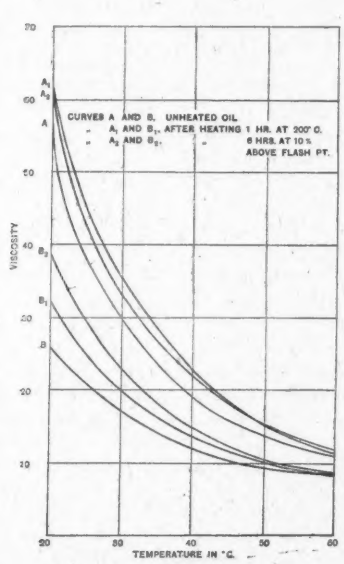

CURVES A AND B. UNHEATED OIL.
" A_1 AND B_1. AFTER HEATING 1 HR. AT 200° C.
" A_2 AND B_2. " 6 HRS. AT 10 % ABOVE FLASH PT.
VISCOSITY
TEMPERATURE IN °C.

FIG. 6.

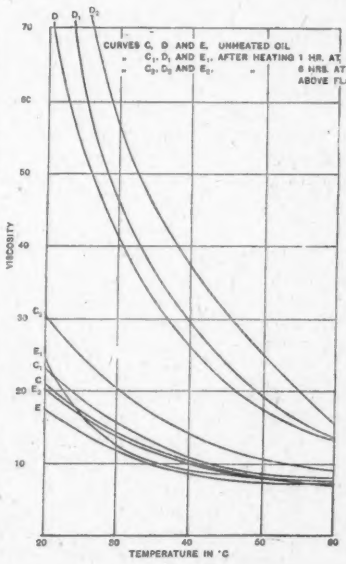

CURVES C, D AND E. UNHEATED OIL
" C_1, D_1 AND E_1. AFTER HEATING 1 HR. AT 200° C.
" C_2, D_2 AND E_2. " 6 HRS. AT 10 % ABOVE FLASH PT.
VISCOSITY
TEMPERATURE IN °C

FIG. 7.

The results of these tests, however, were disappointing so far as enabling any test to be established that would indicate the liability of an oil to form deposit was concerned. The physical changes are far more marked than the chemical changes; the latter are very slight and irregular, being affected apparently almost entirely by impurities. Of the physical changes, the most marked is the increase in viscosity, and it was hoped that the increase might be a measure of the deterioration of the oil due to heat; this, however, was not found to be the case—the increase in viscosity bears no relationship to the liability of the oil to form deposit. Fig. 6 shows the increase in viscosity of two oils after heating one hour at 200° C., and six hours at 10 per cent. above the flash point. Both these oils behave exceedingly well during heating tests, and would not form deposit in service. Fig. 7 shows the increase in viscosity of three oils, all of which form deposit in service. Oil E forms deposit more readily than oils C and D, and oil D forms deposit more readily than oil C.

The increase in viscosity is sometimes accompanied by slight increase in specific gravity and flash point; any increase of these, however, is no indication of the extent to which deposit will be formed.

The foregoing outlines laboratory tests that may be easily carried out, and the results can be relied on if a uniform method of test is adopted; one precaution only need be emphasised, and that is the necessity for maintaining a uniform temperature throughout a sample by stirring, or adopting such methods as shall prevent local heating.

It now only remains to deal with the chemical changes in the oil due to heat, and the deposits obtained by heating tests and from transformers in actual service. The physical changes produced by heating are accompanied by chemical changes in the oil, the most marked of which is increased acidity. This increase is affected by the temperature and length of time it is maintained, and also by oxidation during heating. The acidity, however, is not increased by oxidation without heat, and the amount of increase cannot be taken as a measure of the liability of an oil to form deposit.

The saponification value is also increased by heating, and the amount of oxidation during heating, but is unaffected by oxidation without heat. The increase in no way indicates the liability of an oil to form deposit.

Impurities in the oil become more pronounced, but these are usually present in such minute quantities as to neither form any deposit nor cause discoloration.

The deposits formed by the heating tests have been so small in volume that it has been impossible to carry out any thorough investigations upon them. Their separation from the oils is an extremely tedious and difficult matter, since they are of such a fine nature that they remain in suspension for many hours, and in some cases even days. The deposits obtained with different oils vary considerably in their nature and colour. They vary in colour from a light brown to a dark chocolate, and some have quite a wax-like appearance. The variation in colour seems to be affected by the colour of the oil at the completion of the heating test. The yield appears to be a definite quantity from a given volume of oil, and, though more readily formed by a high temperature, the quantity is not greater than that formed by a low temperature for a longer period of time. On heating, they either exude oil, melt, or turn to a black bituminous substance that is quite tacky when hot.

With regard to the deposits obtained from transformers in service, it has not been possible in every instance to make an examination of the transformer, though this has been done in the majority of cases.

The deposit is generally quite uniformly distributed over the transformer, and no evidence of its formation by reason of one portion of the winding being at a high temperature has yet been discovered. This may be due to the circulation of the oil carrying the deposit uniformly throughout its mass by convection currents which do not allow it to settle until it is cool. The deposit formed in an oil-immersed transformer in service, however, is, on removal, totally unlike in appearance to the deposits formed by heating tests. It is generally a thick sludge or slime which may be rubbed down to an oil between the fingers. Its distribution is general, not only on the transformer, but on the bottom and sides of the tank, for it clings to vertical as well as horizontal surfaces, particularly if they are rough. In water-cooled transformers sometimes the greatest deposition of sludge occurs around the water-cooling pipes. This is objectionable since it retards the cooling of the oil.

In every instance the deposit appears considerable in volume, but when it is removed it has always been found to consist largely of oil. The solid portion of the deposit as it settles retains a quantity of oil which does not readily drain from it when the oil is either run from the tank or the transformer removed. It will, therefore, be appreciated that such a sludge is liable to contain anything that may have been left in the tank before filling, and any impurities in the oil, dirt or scale that may come off the transformer. Examination of the insulating materials of a number of transformers after varying periods of service, even where deposit has been formed, has not revealed any deterioration. The varnishes become slightly discoloured by heat, and the fibrous materials on which they have been used absorb some of the oil; for though the varnishes are insoluble in the oil, they are not absolutely impervious to it in the sense that they can be so applied as to entirely prevent its absorption by the fibrous materials.

A series of oils in which treated insulating materials were immersed and heated by coils, treated with baking insulating varnish, at a temperature of 80° C. for 400 hours, showed no greater increase in saponification value than a series of the same oils maintained at the same temperature for the same length of time under the same conditions of test. Examination of the treated materials and coils showed no softening of the varnish and no deterioration beyond a slight darkening in colour.

A large volume of sludge only yields a small quantity of solid matter, and examination of a number of cases has shown traces of all sorts of impurities, according to the locality in which the transformer has been placed. The oil obtained from it has exactly the same characteristics as the oil in the tank, and it would seem that the solid deposit is of almost the same specific gravity as the oil, remaining in suspension while the oil is hot, and, gradually settling as it cools and forming a kind of emulsion on all the surfaces. The sludge always gives an acid reaction, though it is more markedly so than the oil, and generally contains considerable moisture.

The saponification value is generally higher than the oil, though it has been impossible to reproduce this by any heating or oxidisation tests on small samples, and has been judged to be due rather to the impurities than to solubility of the insulating varnishes.

Solid matter similar to that formed by the samples of oils submitted to heating tests has been obtained from some sludges, whilst others have yielded a thick oil almost of the consistency of vaseline, and in one case paraffin wax. In the latter case this could only have come from the oil, which had been in service for nine years, but, unfortunately, no information as to the origin or history of the oil could be obtained. The solid matter in the sludge resembled the brown powder formed by the heating tests, and exhibited the same properties.

In one case only has it been possible to obtain a sufficient quantity of this to make a thorough investigation of it, and it then proved to be paraffin wax.

From the examination of the samples after heating and the oils after service, there is evidence to show that the discoloration and formation of deposit are due to decomposition of the oil by heat.

The amount of discoloration and deposit varies with different oils, so-called blended oils being worse in this respect than the pure oils.

Prevention of the formation of deposit is probably impossible by mere blending, and, in general, the lighter coloured oils form less than the dark ones. American oils appear to form deposit rather more readily than Russian oils, though the latter are generally darker in colour.

It is probable that only a pure oil which will completely evaporate at a high temperature, leaving no residue, will fulfil the desire for absolute immunity from the formation of deposit, but the difficulty of obtaining information as to the origin and refinement of an oil renders the task of determining definite reasons for discoloration and formation of deposit one of considerable difficulty. A complete analysis of a number of oils before and after heating tests and service can alone solve the question.

From the experiments and observations carried out by the author, it is now possible to judge how long oil will, under given conditions, remain free from the formation of deposit, and some have been tested that seem likely to be entirely free from this objectionable feature. Such oils can only be obtained by the most careful selection from the crude distillation and refinement. Indeed, it is possible that care in distillation and refinement have a greater influence on formation of deposit than the crude material from which the oil was obtained.

Besides testing oils for transformer insulation, the author has conducted tests on lubricating and organic oils, but the conclusions drawn have been based only on those which could be used as insulating oils, since the physical properties of some are obtained by artificial means, and are not inherent properties.

The market for oil for insulating and cooling transformers, already large, must expand in the future, so that the formation of deposit by oils is a matter that must receive greater attention from oil refiners than it has received in the past.

In conclusion, the author's thanks are due to Messrs. R. P. Boyd, E. L. Buttenshaw, R. Dodds, S. Evans, L. D. Hill, L. H. Page and A. White, for the care they have exercised in carrying out laboratory experiments.

Mexico.—H.M. Consul-General at Mexico City reports that a company, which was incorporated in August last in Ontario, Canada, with a capital of about £3,080,000, for the purpose of carrying on outside Canada the business of an electric light, heat and power company in all its branches, and also of constructing in Mexico railways, tramways, telegraph and telephone lines and works in connection therewith, has now been registered in Mexico City. H.M. Consul-General is informed that the company will obtain its power from falls on the principal rivers in the States of Nuevo Leon and Tamaulipas, and from the River Naranjo in the State of San Luis Potosi. It is intended to extend the power transmission lines to Monterrey, San Luis Potosi, Tampico, and other principal cities of the north-east of Mexico. Contracts have been made for the hydraulic and electric works, and for the construction of the transmission lines. The constructional works are to be completed within 18 months.—*Board of Trade Journal.*

PROCEEDINGS OF INSTITUTIONS.

Notes on Standards for Electrical Machinery.

By DR. ROBERT POHL, M.I.E.E.

(*Abstract of paper read before the* INSTITUTION OF ELECTRICAL ENGINEERS, *Leeds, December 6th, and London, December 7th*, 1911.)

THE "British Standards for Electrical Machinery" were issued by the Engineering Standards Committee in August, 1907 (report No. 36). Their main provisions are identical with those contained in the interim report (No. 17) published in 1904. This first step in the direction of standardisation was necessarily of a tentative nature. It was so, unfortunately, to such an extent that it exerted but little influence.

It will be further admitted that in an industry progressing so rapidly as the manufacture of electrical machines, standard rules, even if quite satisfactory at the date of issue, will not remain so for more than a few years. Under these circumstances it is natural that criticism of the present rules and suggestions for a decisive advance in the direction of standardisation should have lately become more frequent.

Such standards, if generally adopted, must prove of immense value to the manufacturer, by enabling him thoroughly to standardise his machines, with consequent appreciable reduction in the cost of manufacture. Judging from this point of view, the British Standards of 1904 to 1907, in contrast to the German "Normalien," can only be termed a complete failure.

The British Standards are not comprehensive, and they have practically remained a dead letter. To make the standards effective, they must be brought forcibly to the notice, not only of the manufacturer, but of the buyer and user of machines. It would further be essential to secure adoption by the leading insurance companies and the Government Departments as far as possible. If these and other suitable steps were taken to force the attention of all concerned upon the standards, I feel convinced that an immediate change would come over our industry.

Due to the existence of generally accepted rules, and to the fact that the consumer is accustomed to adjust his plant so as to suit the manufacturer's standard outputs and speeds, the German firms can produce standard machines in large quantities by piece-work methods and sell them from stock. On the other hand, generally speaking, British firms manufacture individual machines in the absence of accepted standards, and competition forces them to quote to almost any specification and for any desired output and speed.

Two methods of working are recognised by the Committee, viz.:—(*a*) Continuous working; (*b*) Intermittent working. A third, "short-period working," is recognised by the German and Belgian Standards.

(*a*) A machine for continuous working is defined as one which can work continuously for six hours and conform to the prescribed tests. I suggest that the words "for six hours" be eliminated and that the following definition be adopted: "The output of machines for continuous working shall be the output at which, with suitable attention, they can work continuously from week-end to week-end. Their suitability for this shall be proved by their passing the prescribed tests."

(*b*) When framing the definition of intermittent working, the Committee were aware that the 1-hour test used for this definition did not meet the requirements of the industry, leading to unnecessarily large motors.

The following definition may be submitted: "The output of motors for intermittent working shall be the output at which, with suitable attention, they can work from week-end to week-end intermittently with the specified load factor. Their suitability for this shall be proved by their passing the prescribed tests."

I further suggest that only three standard load factors be adopted—namely, ½, ¼ and ⅛. The load factor ½ is generally applicable to motors for lifts and for severe crane and hoist work; ¼ for ordinary shop cranes (lifting and travelling), &c.; ⅛ for traversing and other light duty.

The present standards give the classification of motors with reference to the degree of protection under four headings—*i.e.*, open, protected, ventilated, and totally enclosed. This classification should apply to machines generally, and not merely to motors. The developments of the last few years have made it necessary to extend the list by the addition of flame-proof enclosed machines as used for mining purposes. A flame-proof enclosed machine may be defined as one in which all live parts are enclosed in a casing or casings, so designed as to withstand the effects of an internal explosion and to prevent the transmission of the latter to an outside explosive atmosphere. This definition would comprise the two known classes of flame-proof motors, the non-ventilated or long-joint type, and the ventilated or grid type.

The recommendations under the heading of wearing depth of commutators, especially those for the larger diameters, go considerably beyond what corresponds to good modern practice. A wearing depth of 1½ in., for instance, is justifiable only on the assumption that the corresponding commutator will require grinding up or turning some 30 to 40 times during the useful life of the machine. Such a provision was hardly necessary even in the days of copper brushes and glass paper. The advent of carbon brushes and commutating poles, coupled with improvements in the mechanical design of commutators, has resulted in the fact that turning or grinding, except perhaps shortly after erection, has become altogether unnecessary. A revision of the figures is desirable, not only in the interest of the manufacturer exposed to international competition, but also in order to save the purchaser useless expense.

Ruling British practice requires stringent conditions on sparklessness. I suggest the following clause: "There shall be practically no sparking at the brushes of commutators or slip-rings at any load up to and including full load, and no injurious sparking at the specified overloads, and the position of the brushes, except where otherwise stated, shall remain fixed for all loads."

There is no difficulty in complying with these conditions in modern machinery, and the corresponding clauses in the French, Belgian and German standards appear to be unduly lenient.

As regards overload capacity, we find a very striking discrepancy between average British practice, which has adopted very large factors of safety, and the French, Belgian and German standards. The last specify 25 per cent. for ½ hour, and 40 per cent. for three minutes, whilst, according to the French and Belgian rules, it is 20 per cent. for a period equal to $\frac{1}{10}$ and ½ respectively of the full-load run. On the other hand, British specifications generally ask for an overload capacity of 25 per cent. for two hours, 50 per cent. for ½ hour, and the standard machines of good makers will stand up to this without difficulty. Judged from this point of view only, they are on an average 20 per cent. larger in output than Continental machines made for the same nominal output and complying with the respective country's standard specification.

In view of the fact that modern well-ventilated machines reach their final temperature after a comparatively very short run, an overload of two hours' duration is an unnecessarily severe test for small and medium sizes when following upon a continuous run. I suggest that 25 per cent. for one hour, 100 per cent. momentarily, be adopted for machines for continuous rating, and 25 per cent. for five minutes, 50 per cent. momentarily, for intermittently working machines. Generators should be capable of maintaining their full voltage up to 25 per cent. overload (15 per cent. in the German specification) when running at their full-load speed, the power factor in the case of alternating-current generators being equal to the normal power factor.

A clause fixing the loads for which the efficiency and power factor should normally be stated, and subsequently tested, is desirable. Under ordinary conditions the full-load and half-load figures are sufficient. A regulation is further desirable stating by which method the efficiency is to be ascertained. I suggest that the measurement of the individual losses be adopted as the standard test, where not otherwise agreed upon, in view of its simplicity and of the ease and accuracy with which it can be carried out under almost any commercial conditions.

No hygroscopic materials such as cotton and paper should be employed in electric machines unless they are thoroughly impregnated either before or after winding. I suggest that all windings for working pressures above 200 volts be flashed to earth with alternating current of twice the working pressure, but not less than 1,500 volts; windings for less than 200 volts with 1,000-volt alternating-current. The pressure should be raised gradually for this flash test, and the full voltage be applied for one minute.

There is an extreme diversity of view as to the highest permissible temperature rise, which reflects itself in the specifications. The rise specified varies between limits as wide as 25 and 55° C.

The investigations of the National Physical Laboratory, made on samples of cotton-covered wire, lead to the conclusion that cotton, when exposed for prolonged periods to temperatures up to 125° C. (257° F.) undergoes no serious change. Above 125° C. it darkens in course of time, without, however, losing its insulating qualities, and even at 180° C. it proved an excellent insulator from the electrical point of view. Judging merely by change in colour, 125° C. (257° F.) is given as approximately the safe limit.

Impregnation reduces to a certain extent the deleterious effect of high temperatures on the mechanical properties. In view of the above, I submit that we work with an ample margin of safety if we limit the highest internal temperature of field coils to 125° C.

For direct-current armatures and alternating-current stator and rotor windings a more conservative rating is desirable, in view of vibrations and high differences of pressure between layers. I suggest the rules should be framed in such a manner as to ensure that the highest internal temperature of distributed windings will in no part exceed 110° C.

The British standards give the highest temperature of the atmosphere permissible for standard machines as 25° C. (77° F.), whereas the German rules are based on an air temperature of 35° C. as a maximum. I strongly urge that the same figure, *i.e.*, 35° C., be adopted as the basis for the British standards, in order to meet the requirements of the export trade.

Average British practice, as distinguished from the "British Standards," permits a rise of 70° to 75° F., or about 40° C., as measured by thermometer on the surface of any stationary or moving coils. This is lower than required in the interest of safety where distributed windings are concerned, in which there is only a small difference between the highest temperature in the interior of the coils and the surface temperature. It is justifiable, however, in the case of stationary field coils, in which the highest internal temperature rise may be even 3½ times as high as the rise of the surface.

The present practice of judging field coils from the temperature rise measured on the surface is not only unscientific, but may be misleading to the point of danger. This is generally becoming more serious with the employment of forced ventilation, which must necessarily raise the internal temperature gradient. So long as the surface temperature is made of foremost importance there is little inducement for manufacturers to introduce methods of design and ventilation leading to a low temperature gradient inside the coil.

In view of these or similar considerations, the Engineering

Standards Committee in 1907 followed the decision come to a few years previously by the German Institution, viz., that the temperature of field coils shall be measured by the resistance method. The increase in resistance indicates the mean instead of the surface temperature, and is therefore considered to approach more closely the all-important peak value.

"The permissible temperature rise for stationary coils (by resistance) is 60° C. (108° F.)."

The recommendations of the British standards relating to temperature tests have made practically no impression on the British electrical industry. The resistance method is not adopted in more than, perhaps, one case in 100, and where it is specified its spirit is frequently misunderstood, and a temperature rise of about 40° C., usual for surface

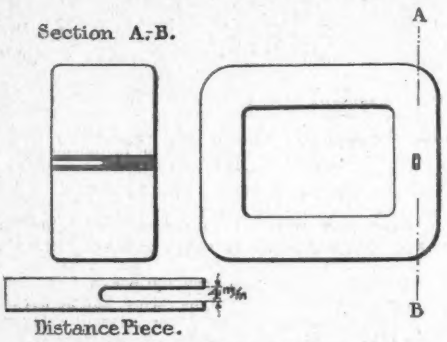


FIG. 1.—DISTANCE PIECE FOR FIELD COILS.

measurements, is specified to be obtained by resistance method. As it requires the measurement of the resistance cold in addition to the warm resistance, definite conclusions cannot be obtained from the state of the machine at the end of the test only. The method furnishes, after all, only the mean temperature of the whole field circuit, and takes no account of the discrepancies in the temperatures of individual coils. In spite of its almost universal official recommendation, it represents by no means an ideal solution of the problem.

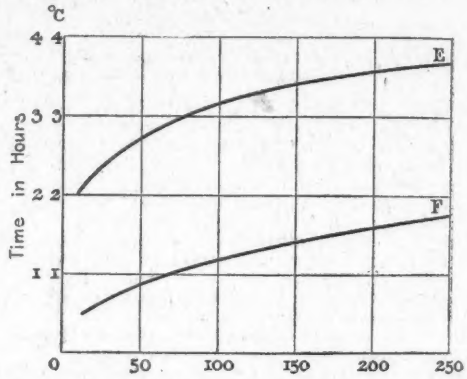
It is possible, without serious inconvenience, to provide for a direct measurement of the internal temperature by means of the thermometer. It is only necessary to this end to wind into the field coil, at a point where the maximum temperature may be expected, a distance-piece of wood or other insulating material enabling the subsequent insertion of a thermometer. Fig. 1 indicates the arrangement of the distance-piece for field coils. To receive a thermometer about 3 mm. thick, the distance-piece need only be 4 mm. wide, and would not add to any appreciable extent either to the external dimensions or to the cost of the coils. In a series of tests carried out on coils as shown in fig. 1, the internal thermometer registered in all cases a temperature rise between 12 per cent. and 20 per cent. higher than was ascertained by the resistance method. In the case of very small machines, below, say, 10 H.P., the temperature of the surface is a sufficient indication of the internal rise.

According to the present British standards all stationary coils must be tested by the resistance method. For rotating coils the rule applies that they shall be tested by resistance method whenever practicable, but in the case of all distributed windings, it is generally possible to find portions, the temperature of which, as measured by thermometer, is at least as high as the mean temperature of the whole winding measured by resistance method. Furthermore, the resistances in question are mostly of a very low order, and their accurate measurement is frequently impracticable on site. The resistance method is also unsuitable for windings in which equalising connections are employed, as it will give no indication of the temperature to which the latter will rise. Under these circumstances there appears to be no justification for retaining the resistance method for distributed windings, the simple thermometer test being preferable from all points of view.

The present rules provide for a 6-hour test for all rotating machines irrespective of size. It is well known, however, that very small machines may reach their final temperature within less than one hour, whilst large slow-speed generators and alternators require sometimes more than 10 hours to reach a settled state. I submit that one gets near enough the final temperature rise in modern rotating machines if the temperature at the end of the run is still rising at the rate of 1° C. during the half hour.

The curve, fig. 2, giving the time required for well-ventilated machines to approach their final temperature, will perhaps be surprising to those not in intimate contact with modern developments. It appears that under the suggested rule a 10-H.P. protected type motor need only be tested for two hours, a 50-H.P. protected-type motor for 2¾ hours, and the error introduced by reducing the testing period to these low figures is less than 1° C. in both cases. Summarising, I suggest the following rule: The duration of the full-load test shall be such that the temperature rise shall not increase by more than 2 per cent. during the last half-hour of the run. In order to ascertain this, a thermometer fixed to a suitable stationary part of the machine shall be employed.

The permissible temperature rise, as ascertained by the specified tests, must be such as to ensure that in the interior of field coils the actual temperature of 125° C., and in distributed windings 110° C., is not exceeded. The highest rise must, in consequence, not exceed 125 — 35 = 90° C. and 110 — 35 = 75° C. respectively. For distributed windings, such as D.C. armatures, A.C. stator and rotor coils, which must be measured by thermometer on the surface, an allowance must be made for the temperature drop in the outer insulation and in the interior of the coil. The sum of these is not likely to exceed 20° C. In addition we will allow 5° C. to meet the discrepancy due to reducing the duration of the test, or a total of



Curve E.—Hours run for temperature rise of 1° C. in last half hour.
" F.—Difference between final temperature and temperature after run for 1° C. rise in last half hour.
Final temperature rise 50° C.

FIG. 2.—HORSE-POWER OF PROTECTED TYPE MOTOR.

25° C., leaving a rise of 50° C. In the case of field coils for D.C. machines and alternators, if measured by internal thermometer, the margin to be allowed consists of 10° C. possible error due to the thermometer not being placed at the point of highest temperature, and 5° C. on account of the reduced length of run, leaving a rise of 75° C. This is, in my view, a much safer specification than the usual one of 40° C. rise measured at the surface, and also safer than the present recommendation of 60° C. measured by resistance method.

Where special materials designed to resist high temperatures are employed, a much higher temperature rise is rightly permitted by the present standards, but the exact amount is left to agreement. The development of such well-known materials as asbestos and enamel-covered wires, which are bound to become of great importance, might well be encouraged by allowing definite higher figures where they are employed.

Single-layer windings of heavy copper strip, wound on edge, as largely employed for commutating poles, and sometimes for alternator coils, would also be quite safe if one allowed a temperature rise of 75° C. as measured by thermometer on the surface, seeing that such coils possess an almost uniform temperature throughout.

There need be no limit to the temperature of squirrel-cage rotors, unless ordinary soldered joints are employed, for which the approximate limit of safety is a temperature of 150° C.

The provision for 115/110-volt armatures in a series of standard D.C. machines leads to many difficulties due to the great length of the commutator. Happily this pressure continues to be employed only in a few small private plants, and, generally speaking, it should be discouraged. I also suggest the replacement of 525 and 500 volts by 580 and 550 volts respectively.

For ordinary industrial purposes a 25-cycle supply has important disadvantages, and its adoption renders the standardisation of machinery appreciably more difficult. The frequency of 40 cycles has been largely adopted for private installations, and is the standard frequency of some of the largest supply authorities in the country. It is approximately the lowest periodicity at which metal-filament lamps may be employed without discernible flicker, and it leads to higher power factors compared with 50-cycle circuits, especially where slow-speed machinery has to be installed. From the manufacturer's point of view the provision for 40-cycle machines in connection with a system of standard 50-cycle motors and alternators would cause no serious difficulty.

The tables for motors given in the standards of 1907 unfortunately contain only one speed for each standard output, and the output steps are too big. These lists fail to satisfy the greatly varying requirements of the user. It is particularly essential that for every standard output there should be a reasonable number of standard speeds arranged with approximately uniform steps.

The irregularity in the steps of motor output and speed, and consequently in the frame steps, would embarrass a designer if he were to attempt laying out a systematic line of machines on the basis of the present recommendations. On the other hand, the prospective purchaser of a motor when referring to the list is likely to find the speed given so far different to the one most convenient under the circumstances, that he proceeds to send out inquiries without any reference to standards, whereas a table of four or five speeds would most likely contain one quite near enough to his requirements.

I suggest that we decide on three classes of machines—namely, small machines, frame figure (B.H.P. per 1,000 R.P.M.) below 10; medium size machines, frame figure between 10 and 750; and large machines, frame figure above 750; and that we fix the output steps for each class as follows:—

Small motors, output steps 100 per cent. to 50 per cent.

Medium-size motors, output steps 25 per cent.

Large motors, standardisation of these may be left to manufacturers for the present, as they are not made in quantities.

The outputs suggested are as follows:—

Small motors, ½, 1, 2, 3, 5, 7½ H.P.

Medium-size motors, 10, 12½, 16, 20, 25, 32, 40, 50, 62, 80 100, 125, 160, 200, 250, 320 H.P.

The first line of standard speeds must also be chosen with approximately constant steps, so that equal frame steps are obtained, especially for the medium-size machines.

SMALL MOTORS.

B.H.P.	R.P.M.	$\frac{B.H.P. \times 1,000}{R.P.M.}$	Output step. Per cent.	Speed step. Per cent.	Frame step. Per cent.
½	1,650	0·303			
1	1,500	0·666	100	10	120
2	1,350	1·480	100	11	122
3	1,225	2·450	50	10	65
5	1,100	4·550	66	11	85
7½	1,000	7·500	50	10	65

[Tables based on these principles are given in the paper, and shown to meet all requirement with very few frames.]

In the case of polyphase motors for 40 cycles, seeing that the step from 40 cycles to 50 cycles is 25 per cent., and this equals the output steps, we may use the whole list of standard 50-cycle machines and run them as 40-cycle motors with correspondingly slower speed and the next lower standard output, without any alteration except to the stator winding.

For the standardisation of alternators, it will be desirable, instead of making new patterns throughout, to employ as far as possible the mechanical parts of the polyphase motors. For this and other reasons, I suggest that the principle of 25 per cent. output steps be adhered to, and that the standard outputs in kilovolt-amperes be as follows: 10, 12½, 16, 20, 25, 32, 40, 50, 62, 80, 100, 125, 160, 200, 250, 320, 400, 500 K.V.A. These figures are the same as the B H P. figures suggested for motors. This list would hold good for 50 as well as for 40-cycle machines, the same frames being employed. The standard polyphase alternators could, of course, be wound for single-phase, and in this case the list of outputs might again be left unaltered. By way of example, the 500-K.V.A. size, if wound for single-phase, would be designed to give 320 K.V.A.

The output list of three-phase transformers should be identical with that of polyphase alternators, so that the above figures are again applicable. If a line of single-phase transformers were developed by using in all cases two cores of the standard three-phase transformers, the output list need not be altered, the 500-K.V.A. transformer for three-phase corresponding with the 320-K.V.A. size for single-phase, &c.

It should be clearly recognised that the proposed thorough standardisation is likely to be a success only if it is to the advantage of both producer and user. Engineers cannot be expected to adopt the standard specification and, wherever practicable, to adjust proposed plants so as to employ standard machinery unless it is clearly to their or their clients' benefit to do so.

In opening this discussion, MR. HARDING CHURTON said he had said, in Leeds, that the system of individual standardisation had produced good results, but the adoption of general standardisation would have retarded progress. There was, however, an opening for general agreement on matters, such as rating and testing on standard lines. There was a great variety of supply systems in use, and it would be difficult to provide a number of standard outputs for each one. He agreed with the author as to the arbitrary nature and indefiniteness of the standard six hours' running test, but considered that the one-hour test for intermittent use was also open to question. He had found that a ventilated motor run for one hour continuously, had the same temperature rise as if run for a period with a rate of intermittency of three in four. The same motor totally enclosed was run on the half-hour rate, which corresponded to one in six intermittency. The methods of testing with A.C. could not be commonly applied in the case of D.C.

MR. W. E. ROBSON said the Engineering Standards recommendations were known to be a dead letter; if manufacturers would agree faithfully to keep to the specified performance, and if foreign manufacturers could be prosecuted for selling machines with inferior performances here, then something might be done. The purchaser generally considered price in the first place, and cheapening of the cost of manufacture without an agreement as to price would not benefit the manufacturer, as the selling price would be lowered. The author's tables for machine outputs gave even more steps than were at present used, and did not represent any advantage. Looking at the matter of standardisation from another point of view, the designer of a costly machine could not be expected to alter his design for the sake of the motor which would drive it, and would cost only a fraction of the whole. The great fault was that too many firms were building the same sized motors and dynamos, and an agreement to alter this and divide orders according to sizes would lead to a great saving in production costs and in other directions. He had come to the conclusion that electric motors would eventually be excluded by law from fiery mines, and that such motors need not be considered.

MR. ROBERT HAMMOND defended the Standards Committee who made the original recommendations. The paper was a valuable one, and the criticisms which it contained would be of assistance when the rules were revised in the near future. He suggested that all the good stuff the author had included had actually been obtained in the interests of the Committee by the National Physical Laboratory. The standard test would certainly give a good machine to the client, in whose interest it was adopted. The author's remarks on temperature rise were made under a misapprehenson, as the Committee specifically provided for the case of the temperature being above 25° C.

PROF. S. P. THOMPSON disagreed with the author's recommendation that machines for 100 and 115 volts should be disregarded. From the consumer's point of view, such pressures were very suitable under existing conditions. He described a method which would render unnecessary a 6-hours' run to find the eventual temperature of a machine.

MR. H. A. JONES considered that British manufacturers quite held their own in machines of up to 100 H.P., and that foreign competition was negligible; this, in spite of the lack of standardisation and manufacturing facilities here. He thought machines were purchased more on the reputation of the maker than on the strict guarantee.

Atmospheric Phenomena and Over-Voltages in Overhead Transmission Lines.

By MR. G. V. ADENDORFF.

(*Abstract of paper read before the South African* INSTITUTE OF ELECTRICAL ENGINEERS, *Johannesburg, August 17th*, 1911.)

IN the case of a power company supplying a mining consumer (where a comparatively short stoppage of supply may involve the loss of a large sum of money) it is usual for the power company to compensate the consumer in the event of the supply failing; consequently it will be seen that continuity of supply is an item of prime consideration, and no effort should be spared to attain such a condition of working.

Disturbances due to atmospheric phenomena are obviously only found in overhead circuits, whilst underground cable systems are free from them, unless connected to overhead lines. In the latter case, the disturbances generally are more pronounced and dangerous owing to the combination of the relatively large capacity of the cable system, and the high inductance of the overhead line.

The main items which come under the category of atmospheric phenomena, and which, directly or indirectly, are connected with the production of over-voltages, may be simply classified as follows:—

1. Temperature effects; (2) altitude effects; (3) rain, snow and hail storms; (4) wind and dust storms; (5) atmospheric electrification; (6) thunderstorms.

1 and 2 may be considered together. It is found that sudden changes in temperature, such as occur at sunrise and sunset, produce static charges on conductors—the amount of static being a function of the amount and rapidity of the change in temperature. Similarly, it is also found that a conductor suspended at varying altitudes above the earth's surface receives a decided amount of static charge, depending upon the difference in level between the highest and lowest points of the conductor. Both these effects are probably closely connected with the phenomena of atmospheric electrification.

3. Rain, snow and hail are found to have a static charge, and when either moves in the vicinity of a conductor, the latter takes up a definite charge and becomes electrified.

4. It is easy to show experimentally that a high wind blowing across a conductor causes it to take up a definite static charge, which may, under certain conditions, assume an enormous value. If the wind be accompanied by dust this effect is magnified considerably. Experience has shown that arresters on overhead lines have discharged at various points on bright, clear, windy days, which clearly indicates that the lines had been subject to some rise in potential. Further, linesmen working on dead overhead lines on windy days always encounter static on the lines, and take the precaution of earthing them before proceeding with their work.

5. The result of investigations shows that during fine weather the atmosphere is positively electrified with respect to the earth's surface, which is relatively negative. The potential increases with the height above the ground, and is a very variable quantity. Probably we may estimate as an average a natural potential gradient in the air of about 100 volts per foot.

During wet and changeable weather the potential may be negative, and its value seems to undergo greater changes than usual. This electrification, besides varying with the state of the weather, varies under normal conditions of weather, with the seasons and the hours of the day. The diurnal variation seems to be associated with the hours of changing temperature, the electrification being a maximum at the time of greatest variation in temperature, and a minimum during the hours of constant temperature. Our knowledge of this important phenomenon is very imperfect.

6. There is no doubt that the phenomena of a thunderstorm result from the clouds being in a highly electrified state. If solids or liquids are charged, the electrification resides only on the surface, but gases and vapours, which are composed of minute particles, are capable of receiving a charge throughout their mass.

In the same way moisture particles floating in the upper regions of the air assume the potential of this air, and so have a definite charge given them. It is conceivable that the condensation of water vapour in positively charged air may result in a cloud of positively charged water drops. The dark colour of a thunder-cloud probably results from an extra amount of condensation taking place. The potential in this way may rise to an enormous value.

The maximum tension which air can stand is approximately ½ gramme weight per sq. cm., and whenever the electric tension

rises to this value, disruption occurs, and the well-known phenomenon of lightning supervenes. Calculation leads to a figure of about 5,000 million volts for a lightning flash between cloud and earth 1 mile in length. Since the potential required to produce a flash a mile long is so enormous, it follows that the quantity of electricity required for the energy need not be so great. Sir Oliver Lodge states that 217 million electrostatic units of quantity per square mile would give the requisite bursting tension. Now 217 million electrostatic units are just about 70 coulombs, or not enough to decompose one-hundredth of a grain of water. It must not be supposed, however, that because the quantity is small the current is also small, for if the quantity flows only for a very short time, as in the case of lightning, the current may be exceedingly large, and no doubt this is usually the case.

As a brush discharge would probably occur first, the real potential of the discharge would be possibly a considerably lower figure. The point is, however, that the voltage is of the magnitude of millions of volts.

Lodge distinguishes between two main cases of lightning discharge, and there can be no doubt that both exist:—

(*a*) When the strain on the dielectric near the earth has been of gradual growth, in which case the path of discharge will be prepared inductively beforehand.

(*b*) When the strain arises so suddenly that there is no time for any prearranged path.

The first case he calls "steady strain" and the second "impulsive brush" discharges.

The result of calculation brings out the frequency of discharge at anything over a million cycles per second.

At lightning frequencies the depth of penetration is far less than the thickness of sheets which can be constructed with sufficient mechanical strength. Consequently, the earth path for arresters intended only for high-frequency discharges should be made of thin sheet-iron.

Over-voltages in this paper will be classified according to the mode of occurrence, and so immediately come under the following category:—

(*a*) Direct strokes.
(*b*) Steady electrostatic stress.
(*c*) Impulses or travelling waves.
(*d*) Standing waves or oscillations.

(*a*) If the discharge is very heavy, as usually is the case, the probabilities are that a portion of the section struck will completely disappear, but if the discharge is not so severe, or if, say, one of the poles or masts is struck, then the line at the point struck is suddenly raised to an enormously high potential, and no insulation would prevent arcing over to ground. Such a voltage wave peak would probably set up a wave train which would travel along the line away from the point struck. The greater the frequency the steeper the wave front would be, and the less distance the wave would travel before dying out. It will thus be seen that the effects due to a direct stroke are purely local, and result in puncturing the insulation and consequent arcing over, irrespective of the fact that protective gear may be installed in stations at the ends of the line. Although not the primary cause of danger to the apparatus in stations, they may, of course, set up secondary dangerous disturbances, resulting from an arcing ground or recurrent surge.

(*b*) The gradual accumulation of static charge on a line increases its potential with respect to earth, and in this way the line potential against ground due to "static" may become very great and ultimately may puncture the insulation or discharge over the protective gear, whichever presents a path of least resistance.

If the lightning protective gear is efficient, this potential difference against ground may result in a series of discharges over the arresters following each other periodically. Alternately, with inefficient protective gear, there is a probability of flashing over at the insulators or any weak spot in the insulation.

(*c*) The most complex phenomena connected with lightning discharge are associated with travelling waves. Assume a + charged cloud to move over an overhead line. Then the line and ground will assume by induction from the cloud a negative electrostatic charge. Suppose, now, a lightning discharge takes place between cloud and cloud, or between cloud and ground, then immediately there is a redistribution of the electrostatic field, and the static charge set free moves along the line as an impulse or travelling wave. Such a wave of potential may be enormous, with a steep wave front, which gradually broadens out and flattens until it reaches the end of the line.

Another source of impulses is that due to electro-magnetic induction arising from a lightning discharge. A direct stroke passing over an overhead line will electro-magnetically set up impulses on the lines due to induction. The impulse in this case is only really serious when the stroke passes parallel to the lines, and so is more severe when discharges take place between cloud and cloud than when occurring between cloud and ground.

Whilst in the case of direct strokes the damage done is generally localised, the effects due to impulses originating from induction are felt throughout the system. Travelling waves directly cause most damage to transformers on the line, and it is often observed that the first few turns only on the transformer are punctured. This puncturing generally occurs between two conductors and seldom between the whole coil and earth.

If the frequency is very great the wave length is very small, and the whole potential may then occur between two neighbouring conductors of the winding, so that a puncture may occur, even if the potential of the impulse is not necessarily high. When the impulse reaches the end of the line a new disturbance is set up; the waves are reflected back on to the line again, or partially reflected and broken up by choking coils, and so produce *standing waves*, in which the voltage has maximum and minimum values at fixed points of the line. When the potential of the travelling wave is at its maximum at the end of the line, the maximum voltage of the reflected wave is twice that of the incoming wave. In this way very high voltages, sufficient to puncture insulation and produce arcing generally, may be set up at the station.

Any circuit disturbance may produce oscillations containing only the very high-frequency harmonics, and in this case is purely local, but it may become general throughout the system by including the lower and fundamental harmonics, and in this case it is known as a "surge." In this case, the power which oscillates is the generated power of the system, and the destructiveness of the oscillation is dependent upon the available generated power, and is independent of the power of the disturbance which primarily caused the oscillation. For this reason internal surging set up by external influences is so very dangerous. High-frequency oscillations, such as standing waves due to lightning discharge, are mainly dangerous then, owing to direct puncture of the insulation and to the liability of producing low-frequency surges.

The four types of disturbances which have been discussed may occur singly, in groups, or all may occur together or successively. A direct stroke and static charge, for instance, sets up a travelling wave. A travelling wave breaks up at a station into standing waves. A standing wave punctures the insulation and causes a short circuit, which may produce, on rupturing itself, a high-power, low-frequency surge. A similar effect is produced by a static charge discharging to ground.

The only protection against the possibility of a direct discharge on to the line is the use of lightning conductors on each pole. If the poles are made of wood this becomes practically essential, but if the poles are of metal the use of lightning rods becomes unnecessary. There is no doubt that the overhead guard wire, if properly earthed, affords a good method of protection, in that it acts as a lightning rod, *i.e.*, its action in this case is entirely preventative and not curative. Again, there is the possibility of a discharge on to one of the poles taking the overhead guard wire as an earth in preference to jumping on to the line and then over the insulator to earth, but when a direct discharge takes place there is so much "side flashing" occurring that it is impossible to say how and where the discharge will distribute itself.

The problem of dealing with static charge consists in designing a piece of apparatus which will continuously conduct away the charge and at the same time offer an enormous resistance to the line voltage. There are, at any rate, four well-known methods of dealing with this trouble.

1. The line may be earthed through a choking coil whose self-induction is regulated to carry, say, about ·1 ampere of the line current. Such an apparatus constitutes a complete earth for static charge, without causing any serious disturbance to the system, and as the normal line current flowing through it to earth is very small, and at the same time wattless, the energy lost is also very small. In practice the choking coil is made like a transformer with only a primary coil, one end being connected with the line and the other to earth.

2. Another method is to earth the line by means of a water-jet earthing arrangement. In this the line is continually earthed by a jet of water sprayed upon it. At a power station where water is not in abundance the maintenance may prove expensive, and also the apparatus requires a fairly large space, and, comparatively speaking, careful attention.

3. There is also the gap arrester method, whether of the horn or multigap type. It may be contended that gap arresters are not primarily intended for dealing with static phenomena, yet, at the same time, if no other protective device is in commission, they have to serve as protection. The objection to this form of protection from static over-voltage lies in the fact that they do not conduct the static charge away continuously. The device only becomes operative when the static potential has risen to a value sufficiently high to jump the gap, and consequently the potential may have risen to a dangerous value before the device operates. Moreover, supposing the device operates safely, there is the trouble which may occur owing to the dynamic current of the line following the static discharge.

4. Lastly, there is the method of earthing the neutral. Earthing the neutral of a generator is quite feasible where the generator operates at line voltage, but it introduces the question of the third harmonic voltage, which is one of the fundamental causes of induction in telephone lines. The second method of earthing the neutral is quite extensively carried out, and consists in having an idle transformer on the line, whose line winding is starred and secondary winding meshed. Provided a sufficient number of transformers is distributed over the system, this method is probably the best, although undoubtedly the most expensive.

In grounding the neutral of a system, the greatest caution must be exercised, as there is also the danger of the short-circuit surge being developed through the occurrence of a fault on the line. Grounding the neutral on a system in which an "arcing ground" has developed, would, of course, immediately convert the oscillating arc into a short-cricuit arc, and so into a short-circuit surge. It is safe, however, to ground the neutral with a non-inductive resistance.

With resistance in the neutral there is no likelihood of a short-circuit surge developing, and an arc discharge to ground, so dangerous to the system, immediately forms a dead short-circuit of a current which is limited by the resistance. The resistance should be made as high as possible, but, at the same time, sufficiently low to allow enough current to pass to operate the feeder switch, and so cut out the disabled feeder. Great care must be taken to make the resistance absolutely non-inductive, as any reactance in the

neutral circuit would tend to increase the dangers of a surge, and consequently in all cases the resistance should take the form of a water tank. The tank should be kept enclosed, so as to be free from contact with any matter which would tend to alter its resistance, and for safe operation the water resistance to earth should be periodically tested for standard value.

For dealing with over-voltage due to impulses and standing waves, there are at present four well-known devices on the market—the horn arrester, the multigap arrester, the aluminium arrester, and the Moscicki condenser. The fault of all arresters on the gap principle is the trouble of extinguishing the arc after the arrester has operated. The arc once started is almost invariably followed by the dynamic current of the line, which has then to be broken, and the mere fact of rupturing the current has a tendency to create another over-voltage; unless the resistance to ground is made sufficiently high this danger is always present. The multigap arrester is suitable only for low-power systems. This arrester allows a passage for a lightning discharge, limiting it somewhat, and ruptures the power arc, by means of non-arcing gaps, with considerable effect. The most promising type of arrester for high-tension, high-power systems is probably the aluminium arrester. Its principle and application are both ideal and simple, in that it provides a path to ground through which the normal line current cannot flow, while offering an easy path for lightning discharges. The objections to this arrester are—the electrolyte must be pure or the film will be easily punctured; the arrester must be kept cool, and must always be kept level to prevent the electrolyte from flowing over the edges of the plates; the electrolyte must not freeze, as it becomes inoperative when frozen; and, lastly, it is difficult to insulate the series of plates at the edges. The Moscicki condenser is comparatively a new type of arrester, and has not as yet been in operation in this country, although there are a large number installed on the Continent. In this type there are no horn-gaps in the earth path, the line being connected dead to the earth through a series of condensers. The principle involved is one of capacity pure and simple, and its action is dependent on the fact that a high-frequency current prefers a capacity path to any other. At the line frequency the condenser is inoperative, and it only operates when subjected to a high-frequency surge. It will thus be seen that as far as lightning discharges are concerned, in which the the frequencies are usually very high, the principle is ideal, but as a protection against a low-frequency surge it is valueless. The great feature of this arrester is undoubtedly the fact that at no time during its operation does it allow the flow of the line current, and there is consequently no dynamic arc to break, and no fear of subsequent surging being produced.

Complete protection from atmospheric phenomena can be obtained by putting the lines under the ground, but in cases where this is not possible an alternative is to put the ground over the line. Good protection is in most cases secured by placing a grounded wire above each phase of the line, provided the wires are of good conductivity. The wire should be grounded at every pole, and no expense should be spared in order to obtain a thorough and satisfactory ground. If a system of installing grounded wires on either side as well as on top of the line were adopted, the extra expense would be justified by the better protective results obtained. The main objection to the use of grounded wires is that if the wires become loosened, contact with the line is probable, causing trouble.

There can be little doubt that an effective system of grounded wires affords more protection from atmospheric phenomena than any other piece of apparatus on the market.

The whole question of atmospheric phenomena in this country is of such vast importance to the electrical engineer, that a complete study of the whole subject should receive his careful consideration.

Discussion.

Mr. J. W. Kirkland (vice-president) said he doubted whether such high potentials as 5,000,000,000 volts for a lightning flash ever existed. A lightning flash one mile in length (*i.e.*, from a cloud 5,000 ft. high to the earth) was unheard of. It had not been suggested by men who had investigated the subject. Prof. Elihu Thomson's theory of a discharge was that it was a gradual breaking-down from one end of a cloud to another through various ramifying branches into one common centre of discharge, beginning in an electrical breakdown through a comparatively small distance—50 or 100 ft. Thus it was not necessary to think of such an enormous potential as the author had suggested.

As regarded high-frequency effects, it was not necessary to conceive of tremendously high rates of alternation. One need only conceive of equivalent phenomena, such as a very steep wave. The conditions as regarded electrostatic and electromagnetic conditions varied with that steepness just as they would with very high frequency.

Mr. D. Otter cast doubt on the theory that lightning discharges were oscillatory, preferring a theory that the discharges were intermittent. Such impacts of current would behave to an inductive resistance exactly as a high-frequency oscillating current.

Mr. F. Davidson (Associate Member) was inclined to think that a lightning discharge 1 mile in length had never taken place. He referred to experiments carried out by Mr. G. C. Simpson at Simla in 1908 and 1909, who accounted for the electrification of clouds by a strong upward draught of air.

Mr. R. Soldin thought that voltage rises in networks produced through instantaneous changes of the state of the energy were at least as important to the practical engineer as atmospheric phenomena.

These surges occurred where self-inductions were switched in series with capacities; in switching-out inductively loaded cables or overhead lines; during momentary short circuits, where the harm was so much greater, the larger the plant and the smaller the pressure drop of the generators; and in switching off continuous-current magnets.

Generally up to now the same apparatus had been used for over-pressures which were caused through atmospheric influences, as for over-pressures due to voltage changes in the network, although for the latter the number of cycles generally only amounted to a few thousand per second, whereas one generally took it that the number of cycles for lightning amounted to from 100,000 to 1,000,000. The practical result of this was that for lightning-arrester gear a suitably constructed condenser would be best.

In his opinion the great disadvantages of aluminium arresters were the inevitable horns. Oscillations were generated by the arc itself, to extinguish which always took a few seconds. These oscillations were not only led to earth through the aluminium cells, but also on to the line, and were thereby reflected in the apparatus in conjunction with it, thus causing damage.

As far as he had been able to learn, interruptions and breakdowns occurred very frequently on high-tension power lines in America, in spite of the contrary assertions of interested parties. Moreover, it was the custom not to put down breakdowns of short duration, as such.

With reference to the Moscicki condensers mentioned by Mr. Adendorff, opinions differed greatly.

They had as yet no absolutely safe working protection for over-pressures of high and low frequency, caused by sudden changes of the condition of the energy of the system itself, as well as due to sudden atmospheric phenomena. A large field was open for inventors here.

THE PHYSICAL SOCIETY EXHIBITION.

The seventh annual exhibition of the Society on December 19th was very well attended, and passed off with the usual success. In addition to the exhibition of apparatus, there was a lecture by the Hon. R. J. Strutt, F.R.S., at both the afternoon and the evening session, on "Electric Discharge and the Luminosity that Survives it," and many of the apparatus and processes exhibited were shown in operation. We give below particulars of some of the items of special interest to electrical men.

John J. Griffin & Sons, Ltd.

This exhibit included the Reden oscillating pump for high vacua; Tucker's hygroscopic battery, which gives pressures up to 1,000 volts for charging electrometers and electrostatic voltmeters, and various types of laboratory apparatus. The most striking features were, however, the Rosenhain electric furnaces, shown in use. One was a muffle furnace for temperatures of 900°-1,000° C., as used at the National Physical Laboratory. The heating chamber was a large tube of fused silica, wound with platinum strip and mounted in a

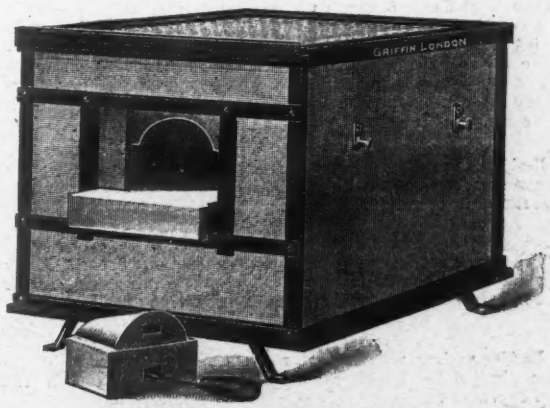


Fig. 1.—Rosenhain Muffle Furnace.

highly insulating casing, the exterior of which was quite cool. The furnace takes about 1,100 watts. A tube furnace with four combustion tubes of fused silica for the determination of carbon in steel was also shown, taking 800 watts. These furnaces are so constructed that the heating elements are readily accessible, and can easily be replaced when necessary. A furnace with a porcelain tube for higher temperatures was another exhibit. Messrs. Griffin also showed "quartz glass" mercury thermometers, made entirely of quartz, and capable of reading up to 750° C. These thermometers have the great advantages that they do not crack when suddenly exposed to high temperatures, and the zero point does not vary, no matter how long the instrument may have been highly heated.

A. C. Cossor, Ltd.

This firm showed the "Rose" patent high-vacuum pump, in which the iron piston is actuated externally by a solenoid traversing

the outside of the cylinder; there is thus no possibility of leakage past a piston rod, and a remarkably high vacuum can be obtained, suitable for exhausting metal-filament lamps and vacuum tubes. A low-vacuum pump for the preliminary exhaustion is mounted on the same base, the whole apparatus being complete without mercury or any auxiliary apparatus.

MARCONI'S WIRELESS TELEGRAPH CO., LTD.

A very interesting collection of apparatus was shown by this firm, representing the standard instruments used at the Marconi stations. The exhibit included the valve receiver, with three inductively connected adjustable circuits combined in one instrument with the oscillation valve detector and regulator—this being the type of detector generally used by the company; the wavemeter, consisting of a simple oscillatory circuit adjusted by means of a variable condenser with ebonite dielectric, a crystal detector and telephones indicating resonance; a multiple tuner and a magnetic detector, which are generally used together for receiving a particular wave-length and tuning out all other waves, with a range from 100 to 2,500 m.; an instructional buzzer for training operators, a direct-reading decremeter for measuring the rate of decay of electrical oscillation amplitude and other functions, and a model of the Marconi land station mast to ⅛ scale of the modern steel tubular type. Most of the instruments were shown in use, and gave an excellent idea of the high pitch of development which has been attained in wireless work.

W. G. PYE & CO.

The apparatus at this stand was mostly non-electrical, but included a simple and compact pattern of potentiometer bridge consisting of a slide wire 20 m. long wound on a grooved slate cylinder. The position of the contact maker can be read to 1/200 of a turn, and there are 100 turns of wire, with a resistance of 30 ohms and a current-carrying capacity of 1 ampere. The instrument can be used for a variety of purposes. A Kohlrausch bridge with contacts arranged on the dial principle was also shown.

SIEMENS BROS. & CO., LTD.

This company exhibited a complete wireless telegraph set on a small scale, representing two stations in operation.

The set has been specially designed for demonstrations in the lecture room, or for simple experiments in the laboratory or in the open air; it operates on the "quenched singing-spark" system, and is a copy of the larger stations employed in practice. The source of energy is a 12-volt accumulator battery, operating an induction coil with a hammer interrupter, producing about 350 interruptions per second. A feature of this coil is the use of a thin U-shaped steel spring on the adjusting screw, making contact with the hammer. This spring vibrates with practically undamped oscillations, and a clear musical note is thus produced. The spark-gap is placed vertically, and is made up of five sections, any number of which up to four may be short-circuited as required.

For the primary capacity four Leyden jars are used, and by means of clips on the primary self-induction, various wave-lengths may be obtained. A helium tube is supplied for the purpose of tuning.

The range of this set, with antenna 16 ft. high, is 1,100 yards, but under favourable conditions ranges up to about 2,000 yards are obtained, and with a special antenna over 30 ft. high messages can be transmitted over distances up to five miles.

A complete outfit called the "Oscillothermex" was shown, in which were combined the apparatus used for diathermy, high-frequency treatment, and X-ray work, in a form convenient for the use of electro-medical practitioners. Frequency and speed indicators of the resonance type, and the "vibragraph," were also shown in operation.

SYNCHRONOME CO.

Besides the standard apparatus of the company the new astronomical regulator with automatically compensated escapement was shown in operation.

SANITAS ELECTRICAL CO., LTD.

The company showed a new pattern of the "Sanax" X-ray apparatus and the "Multostat" universal apparatus, designed for use in hospitals and by medical men in private practice.

NEWTON & CO.

Besides various physical apparatus, some new arc lamps for use in projection lanterns were shown, with rectangular carbon feed and convenient universal adjustments.

(To be continued.)

Citroën Gears.—MESSRS. ANDRE CITROEN & CO., the sole makers of the Citroën machine-cut helical gears, have received an order to the value of £5,000 from the Oerlikon Co. for gears in connection with electric locomotives. We are informed that this contract is the outcome of the successful working of the Citroën gears in the Oerlikon locomotives used in connection with the Loetschberg (Switzerland) Electric Railway.

Germany.—THE WESTFALIA GLUHLAMPENFABRIK GESELLSCHAFT is the name of a new company which has lately been formed at Aplerberk to manufacture incandescent lamps.

CAPITAL AND LABOUR.

As we anticipated, the Miners' Federation on December 21st decided to take a ballot vote on the question of striking for a minimum wage. We are told that the decision was a unanimous one, but we are inclined to doubt this, for the reason that we cannot believe that *all* the men's leaders are so absolutely devoid of intelligence as to think a national strike can in any way compel the consumers of coal to pay a price which is fixed not by supply and demand, but by the amount of wages to be paid to the miner for obtaining it. This is really what the minimum wage amounts to, and it forms the basis of the miner's reasoning in formulating his demand. He is, unfortunately, not aware of the enormous coal deposits of other countries, and no one takes the trouble to inform him either of this or of the fact that coal can be—and, in fact, is—brought into this country in ships.

The passing year, which closes on Sunday next, has been a remarkable one in the number and magnitude of labour disputes, involving fatal rioting and the use of the military in quelling disorder and defending private property. At one period, in fact, it seemed as though we were nearly on the verge of civil war, the disputants being for the most part a band of ruffians led by labour dictators on the one side, and the recognised officials of law and order on the other. During the past few days we have had the strike in Dundee, accompanied by disorder, and the threatened lock-out in the whole of the cotton industry, which, taken in conjunction with the threat of a national strike in the coal trade, make the advent of the New Year anything but a bright and prosperous one.

So far as the miners are concerned, we are inclined to think that the result of the vote will be in favour of a strike, even with the proviso that a two thirds majority is required; for the reason that the individual miner believes the coal-owners and royalty-owners are enormously wealthy, and that they can afford to pay the wage he requires, and, moreover, he also thinks that if the worst paid workman is to get, say, 7s. or 8s. a day, he—if he is a good workman—will have his wages increased proportionately. Again, if the owner cannot pay a minimum wage out of his present selling price, the miner in his limited reasoning capacity thinks it is an easy matter to raise the price of coal to enable this to be done; this, in fact, is the sort of stuff that has been drummed into him for some time past, and its easy logic appeals to him.

In the cotton trade the ruling question is in regard to non-unionists. The labour leaders wish to control the whole of the workpeople in the industry; and, in fact, in every industry the labour leader is climbing to wealth and power, which is fast becoming little short of absolute dictatorship, and the worst of it is these men think they have the support of the Government behind them. One naturally asks what is to be the outcome of all this disturbance and when and how it is to end. In our opinion, the time for ending it is now, and we should recommend the masters in the cotton trade to stick to their guns, as undoubtedly a great principle is involved—viz., that of freedom of the subject—and we believe that many employés now in the Union are only members through being terrorised into joining, and would leave at once if given an opportunity. In our opinion, it was a false move on the part of the Government to *force* recognition, or partial recognition of the Unions in the recent railway dispute, owing to the fact that it creates a precedent for Parliamentary support of the Labour leaders' demand. Once they can force every employé into the Union, the mills or works are practically in the hands of labour, and control and discipline are lost to the owners and managers for ever. As regards the coal-owners, we cannot see how they can do anything but accept the inevitable and make all the necessary arrangements to close down their pits and to keep them closed until they get complete control back into their own hands. At present they are mainly controlled by the "coal-hewers" and "lads." It would, in fact, be a great blessing if they could keep them closed until the "Eight Hours Act" was repealed. Fortunately, there are about two months in which to make all preparations, and in all probability enterprising merchants are already making arrangements to

ship coal into the country as soon as the demand warrants the higher price which it in all probability will mean. We have, however, only to assume that the transit workers will refuse to handle such coal—which is quite likely—to contemplate a state of complete chaos. Then it is that we should expect the Government to do its duty to protect capital, or, rather, property representative of capital, during the terrific struggle, with all the sorrowful and innocent suffering that would undoubtedly be involved. This suffering cannot, however, be avoided—war is always cruel—but the doctor has very frequently to inflict pain to cure the patient, and, moreover, the mental suffering of a near relative is often more acute than that of the patient. It is the same with a large community. For the good of the community it is necessary that pain be inflicted upon an unruly member who wishes to damage it, but in doing so it cannot escape from suffering itself. That is the pity of it all. We sincerely hope, however, that the coal-owners and mill-owners will stand fast, and that everyone else so far as they possibly can will prepare for the coming conflict, by laying in a stock of coal, or making such arrangements as may be necessary to import it, in order to keep their various industries at work, and that every person who has even a slight interest in the welfare of the country will unite in forcing the Government to change their present attitude and to make full—even ostentatious—preparations for the keeping of law and order. Under such conditions the struggle can only be brief, but what is of very great consequence, the result will be both lasting and beneficial.

ELECTRICITY ON THE WHITBY BRIDGE AND HARBOUR WORKS.

By L. H. KING, A.M.I.E.E

During the last three years there have been considerable alterations made in the town of Whitby, with a view to reclaiming the fishing industry and making the harbour a safe port of refuge. The scheme includes a new swing bridge across the River Esk, and the deepening and widening of the waterway, also the construction of two additional breakwaters some 500 ft. long. Contracts have been placed for over £100,000 of work.

The bridge was the first part of the scheme; it was designed by Mr. J. Mitchell Moncrieff, M.I.C.E., Newcastle-on-Tyne, and constructed under his supervision by Messrs. Heenan & Froude, of Manchester. It is made up of two spans, each span being about 200 tons in weight, and these can be swung 90°, so as to leave a clear waterway 75 ft. wide. Previous to the demolition of the old bridge, a temporary bridge was constructed; this had spans suspended by chains and wire ropes, the raising and lowering of each being operated by a 13-H.P. series-wound motor, driving through worm reduction. The motors were controlled by liquid controllers, and were most satisfactory; they were worked by ordinary labourers, and not a single failure was recorded.

During the construction of the west side foundation it was necessary to sink a large caisson, the air supply for which was obtained from a single-cylinder vertical compressor coupled direct to a 40-H.P. motor; this compressor ran continuously for three months, four days excepted. Space was most valuable, and without a ready supply of electricity the work must have been more difficult. The lighting inside the caisson was by 25-C.P. carbon lamps, used in "cargo light fittings," each containing eight lamps. As previously stated, the new bridge is made in two halves, each half containing its own motor and switchgear.

With regard to the motors, there is nothing calling for a detailed description. Each machine is totally enclosed, compound wound and back geared.

The switchgear (by the Adams Co.) was designed to meet the following conditions:—10 sec. acceleration against full load; 10 sec. normal running; 10 sec. retarding and bringing to dead centre.

Each wing weighs 200 tons, which weight is accurately balanced on a centre pivot, this pivot being fed with oil under pressure. The retardation of this mass was a matter for anxious consideration; the question of wind pressure had to be considered, and the motors had to be capable of exerting full torque during a part of the last 10 sec. at a slow speed, if the ordinary momentum of the bridge was checked by an adverse wind.

Electrically-Operated Swing Bridge at Whitby.

The second part of the work includes the building of the two breakwaters and dredging, &c., and is being carried out by Messrs. Hill & Co., contractors, London. In this case space is again a consideration, and electric power has been adopted throughout.

The work is divided into two sections, East Pier and West Pier; each side has a railway with rope haulage, two cement mixers, a marine stage, and one sand pump which is used as required on either pier.

The railway and cement mixers have a 40-H.P. motor on each pier; the sand pump also requires 40 H.P.

The marine stages are not quite alike; the one on the West Pier has its spuds driven by ropes from the 25-H.P. motor on the travelling crane, which it carries. The East Pier stage has a considerable distance further to travel, and its spuds are driven individually by a motor and worm gear. These motors are of 7½ H.P. each, series wound, and controlled from one central switchboard.

All motors, starting switches and controllers were supplied by the General Electric Co.; they are of their ordinary semi-enclosed type, and housed over by a wooden cover and felting.

It may be of interest to know that these machines have given no trouble whatever. They were, of course, far cheaper in first cost than if totally enclosed, and it has been the writer's experience that on contracts of this sort, a rough-and-ready wooden hut is more suitable than a metal cover; the wood can be easily altered or repaired to suit conditions.

All the gear is on what is acknowledged as one of the most exposed parts of our coast, and has all been drenched with sea-water, but has not given any trouble. The motors have been in use about three years, and there has not, at the time of writing, been a single case of burnt-out armatures or coils.

Current for the work is supplied by the Whitby Council at the usual power rates; a small distributing hut is erected at the entrance to the works, a ·3-twin armoured cable had to be laid for about 500 yards, and is connected into the Flowergate sub-station. The supply to the East Pier is taken from the distributing hut by two V.B. marine cables, laid direct in sand; at sections where shale is exposed, a cut has been made in the shale, a layer of sand on the cable and a thin coating of cement gives good anchorage for these cables, the work of laying which was carried out at low tide, by Messrs. Callender's.

Current for the motors is conveyed down the length of the existing piers by aerial cables, ·1 stranded conductors;

these are carried on single wooden uprights, with pot insulators of the usual type.

The work is all sub-divided, and each section controlled by a Dorman & Smith water-tight interlocking D.P. switch and fuse. The sand pump is fed at various points through a D.P. 100-ampere size foolproof switch and plug.

The whole of the apparatus has proved most reliable; a competent electrician has been constantly employed from the start, and no accidents from electric shock have occurred.

The whole of the electrical work, both for the bridge and for the harbour works, was arranged by the writer.

CENTRAL STATION VIEWS ON HOUSE WIRING.

Our contemporary *Electrocraft* recently contained some interesting impressions of the wiring problem obtained from a number of American supply managers by means of a series of questions sent round by the National Electric Light Association. Although it does not appear what, if any, portion of the replies emanate from municipal undertakings, they suggest that the American point of view is not widely different to our own, and certainly not more unanimous with regard to means for overcoming the first-cost difficulty, which alone to-day prevents the use of electricity from becoming general in houses of small and medium rating.

The question first in the list and in importance: Have you a system for aiding the consumer financially in wiring his house? If so, what is it?" is clothed in language which shows a nice regard for the feelings of the impecunious. It met with a negative reply in one-half of the 160 reports received; from the remainder seven representative cases are given in detail. Five of them carry out wiring through the local contractors, one fears the financial risk, and one carries its own wiring department, which will suggest different reflections on the need of municipal wiring according to the mental bias of the reader.

The terms of payment described appear to be as follows:—

(*a*) Cash if possible.

(*b*) Hire agreement, option of purchase, monthly payments subject to landlord's or other guarantee.

(*c*) By instalments in 12 months subject to contract for supply by meter for three years.

(*d*) Twenty-five per cent. cash, balance on monthly payments plus $1.00 to supply department for carrying the account.

(*e*) By instalments in 12 months.

(*f*) Five lights, surface wiring free, against a minimum charge for energy of $1.00 per month for 12 months.

(*g*) Amount of wiring bill allowed as free supply within one year, three-year supply contract.

(*h*) This correspondent, controlling 75 undertakings, does not appear to have quite grasped the question. In 1909 his method of "aiding" the consumer consisted in getting quotations from local contractors for small house work, then canvassing the public and placing the contracts, presumably recommending those contractors whose quotations were approved of, as he goes on to say that the latter (the contractors), collected their accounts on a cash or other basis.

Apparently a little more "aid" was needed to secure desired results, for in 1910 the scheme was the same plus a commission to the contractor of $1.50 to $2.50 for each house, or 10 to 20 per cent. on cost of wiring; the results are stated to have been very satisfactory. No doubt much peace descended upon the "financially aided" households after the electric light had been duly installed and paid for.

The prices quoted for this class of work are of interest:—

Five-light installations wired on surface at 5s. 3d. to 8s. 4d. per light in small towns, rising to 13s. in centres having a population up to 75,000 persons, cord pendants and carbon lamps being allowed for in these rates.

The wording of the replies suggests that the special facilities apply more particularly along the routes of existing supply mains. The value of these inquiries would have been greater if the current rates for electricity and gas had been printed with the answers.

The second and third questions were directed to ascertain the extent to which technical advice and general educative work was being carried out amongst the public; out of 160 stations 125 replied that no such system was in operation—a surprising result. Unless these consist of very large communities, where presumably contractors and consultants are found in force, it would appear that British practice is in no way behind with regard to business getting. There are few undertakings now in this country without some system of following up possible consumers, and it is generally understood that the station staff can be called upon for free advice. Perhaps, if it were not free, it would be more frequently acted upon.

The selected replies are rather in the nature of counsels of perfection and hardly touch the first-cost problems. Most of the undertakings appear to give advice and to keep technical men to prepare wiring specifications and draw attention to electric utilities other than light. The ideal appears to consist in providing plenty of "outlets" in every part of the house, and ample conductor capacity to enable heating and mechanical devices to be used; nothing is said with regard to metering or charging for such supplies, which makes it difficult to judge of the results attending the programme described.

The fourth query is of real interest, asking clearly if co-operation with contractors is undertaken, and how.

Forty-eight negative replies were obtained, the remainder, presumably 112, work with the local firms. A few representative answers show that technical advice is offered to them, and lists of approved firms are put before the public by the supply authority, which also takes up the technical aspect of the work with architects where possible. As is rightly pointed out, it is often possible for the supply engineers to make advice acceptable to clients and architects, where it would not be so if coming from a wiring contractor with a direct selling interest in the work.

One of the replies refers to a contractor who teaches his men to canvass and pays bonuses for results. This firm, as well as the supply undertaking, conducts regular gatherings at which lectures on current problems are given and technical matters discussed amongst the local electrical workmen. This most valuable practice should commend itself in this country, as has been suggested before in these columns; it would well repay suppliers to make a determined effort to raise the status of all wiremen in their area. The ideas prevalent amongst some of the best workmen with regard to simple theory, and particularly with regard to the cost of using electrical apparatus, are often most grotesque, and give rise to misunderstandings on the part of the consumer which are slow to be discovered and difficult to remove.

A query on the subject of educating architects elicits 105 negatives, and a few sample replies from those who try to carry on this useful work appear to show that the profession must be approached with considerable tact if any good is to be done, which only goes to show that even an American may cling to his own mental outfit, although he carries out the principle of frequent scrapping with regard to everything else. It is without doubt well worth while to obtain the confidence of the local architects, who will generally be found open to receive schemes of lighting for use in their specifications, provided that the advice is put forward by a competent and experienced person, and the architect is allowed to deal with his client without interference on the part of the supply authority.

Questions 6 and 7 ask for an expression of opinion with regard to the influence of present costs on the wiring of houses.

Some two-thirds of the replies suggest that prices are not prohibitive in any general sense. Of the remainder, a few examples call for reductions; one, apparently coming from Chicago, states that, owing to the rigidity of the local wiring rules, deferred-payment systems are necessary to enable persons of ordinary means to face the costs of wiring.

Another points out how frequent are the failures of contracting firms, due to lack of those business methods which can only be employed when a fair amount of working capital is available.

British and American wiring appear to have many characteristics in common.

Some costs for wiring old houses are given, $3.00 to $4.00 per point being quoted, with the suggestion that a reduction to $1.50 is needed to encourage the owners of old houses to have them wired and also to meet the purse of the "poorer class" of householders, *i.e.*, those earning £3 to £6 per week.

$1.50 is mentioned as an average figure for carcase wiring in new houses, which are apparently arranged for electric supply as a matter of course.

The last query concerns any system of wiring which is safe and cheap, and not at present recognised by the National Electrical Code.

One hundred and thirty replied that no such system was known; of the rest the samples are interesting. One asks for a well insulated flame-proof wire which may be pulled or threaded into the building without flexible conduit (presumably the cardboard tube called "loom") and for use with it a special type of "Branch" fuse, which can only be fused up to a certain capacity.

Three of the answers refer to the English "Stannos" system, which appears to be but little known, although attractive to the writers.

There are also references to "knob and tube" work, apparently meaning surface wiring on insulators, with tube ways through walls and partitions. There can be no doubt that this simple system is very suitable for many purposes; its nakedness secures to it a certain amount of care which makes for safety, and it cannot suffer from hidden faults caused at the time of erection, which are so often the cause of failure with the more elaborate metal-cased systems.

The inquiry, which is to form the basis of a hand-book for canvassers and the trade generally, is of interest, but reveals no striking improvement on our own practice, nor any greater development on the commercial side, whilst the growing stringency of American regulations suggests that we should hasten slowly in imitating those rough-and-ready methods which may have done something to promote the rapid growth of the industry in its youth, but which apparently are being discarded as rapidly as possible in its maturity.

EFFICIENCY IN FUEL COMBUSTION.

One-fifth of the coal raised in the United States, both anthracite and bituminous, is used by the railways, which form the largest single group of coal consumers in the land. The amount thus used amounts to 90 million tons annually, the number of locomotives being 51,000, so that a locomotive uses nearly 1,800 tons. This was Prof. Goss's estimate in 1906, and two years later the gross coal production was 410 million tons of 2,000 lb. each. It was estimated by the Federal Conservation Commission that nearly as much coal was lost in the getting. The present practice in the United States is thus like what our own practice once was; the coal owners are greedy and are putting out the more marketable qualities. What is left behind becomes lost, like the huge pillars left in Staffordshire.

In locomotive work not more than four-ninths of the coal represents heat in the steam formed, and with this and friction losses not over 5 per cent. of the heat value of the coal does useful haulage. We think this is over-stated, and should read not over 5 per cent. of the thermo-dynamic possible work.

The figures quoted are from an article in *Cassier's Magazine*, which quotes them from an address by Mr. H. M. Wilson, at Pittsburg. He urges better consideration of economies. The producer gas plant of to-day has an efficiency averaging 13 per cent. of the heat value of the fuel, and there are 500 producer plants in the United States, totalling up to 120,000 H.P. He points out that the waste culm banks at the anthracite mines have been proved to be a valuable source of fuel for producers as well as for boiler furnaces, if briquetted. So also has been proved unnecessary the fuel waste represented by blast furnace and coke oven gases.

Better mining practice should save 25 per cent. of the present annual coal output of 500 million tons, to which enormous total it has now grown.

The Federal Government have done much through the Geological Survey Department by way of helping on economy. They have instituted fuel-testing work and determined the best methods of briquetting coals, and have proved coals to possess coking property which only needed special treatment to bring it out.

In one public building in Washington a saving of £3,000 a year was effected by altering furnaces to burn buckwheat coal in place of furnace anthracite.

The American authorities have advocated the sale of coal on its calorific capacity basis, thus ensuring the sale of the cheaper grades, though the Government is accused, as regards the Navy, of fostering an aristocracy among the coals. For naval purposes, it is more justifiable to use the best coals, for the dirt in inferior coal occupies space of more importance at sea than ashore.

At the Pittsburg testing station, coal is tested under horizontal return tube boilers, and standard makes of water-tube boilers. The furnace baffling is changed from time to time, and firing is done both by hand and machines of various makes. In this way, in a preliminary manner, have been determined the type and arrangement of furnace and its working methods, in order to secure best efficiency.

A bulletin has been prepared showing the analyses and heat values of nearly 5,000 mine samples, and with this an engineer can pretty well determine the sort of coal he can obtain in various parts of the country.

In producer testing, West Virginia coal gave an efficiency 3·3 times what it gave in steam generation, and the lowest grade of lignite in the gas producer beat the best steam coal burned under a boiler. In briquetting, the binder is usually pitch to the extent of 5 or 6 per cent. The mixed mass is heated and put under a pressure of 1 to 2 tons per sq. in. Certain lignites briquetted under great pressure—about 9 tons per sq. in.—were hard and firm like anthracite. Lignite costs 4s. a ton at the pit mouth, and with 2s. for binder and labour, a product costing 6s. is saleable at 10s.

It is stated that in the Western States there are millions of acres of these lignites. An advantage of lignite briquettes is that they can be stored for any reasonable time, and may so be employed to reduce the suffering which results when heavy snow shuts off the supply of fuel in certain localities. But all these finds of fuel, and the most rigid of fuel economy, cannot avail for ever to prevent the approach of the ragged end of a rope of coal supply which is travelling past at a rate of 500 million tons a year.

Over a million tons a day!! Tipped out of an ordinary cart, in touch with each other, these tipped heaps of coal would extend every day a distance of 1,200 miles. Even the stored coal of the United States cannot endure for ever. That it will last our time is certain. Potato-grown alcohol and the cumbrous tidal mill form the staple comfort of posterity to-day. It may be that posterity will laugh at our present day care for posterity in this respect. At least, we will hope so, for the sake of posterity.

"Foster" Festivities.—On the night of December 22nd the Foster Engineering Co., Ltd., celebrated the opening of their new metal lamp factory extensions by means of a tea and concert—the first entertainment of its kind. Both events were a distinct success. Earlier in the day the lamp-capping department was cleared and tables brought in. At 5.30 p.m., when about 300 sat down to tea, the aspect of this room was entirely changed. Apart from definite fixtures, such as annealing furnaces which it was found impossible to remove, one could not recognise the place, which in the ordinary every-day life resembles a human beehive, so transformed was it with holly and evergreens, to which the tinted shades and lamps lent a pleasing note of colour. After the meal, which was served to the accompaniment of music befitting the season, all adjourned to the lamp testing department, where an impromptu stage had been erected. Here, for the space of a good three hours, various members of the lamp factory held the stage in turn. Half way through the evening a bouquet was presented, on behalf of the hosts, to Mrs. Grote, the wife of one of the directors. Mr. Grote, in replying, referred to the kindly feeling that characterised the relations between all departments, individuals, and especially between the directorate, staff and works. "This," he said, "was not only exceedingly gratifying from a personal point of view, but it also expressed one of the essential factors in commercial success, *i.e.*, co-operation."

BUSINESS NOTES.

Book Notices.—*Who's Who*, 1912, 10s. net; *Who's Who Year Book*, 1912-13, 1s. net; *The Writers' and Artists' Year Book*, 1912, 1s. net; *The Englishwoman's Year Book and Directory*, 1912, 2s. 6d. net. London: Adam and Charles Black.—Experience in the past has convinced us of the great usefulness of this series of books. In many business offices, and, of course, in private libraries, they are practically indispensable if one desires to be up-to-date in one's information respecting well-known men and women of to-day. To most writers they are constantly necessary as works of reference. The biographies in *Who's Who* are corrected up to August 31st, 1911, and in the *Who's Who Year Book* are the tables which used to form part of the contents of *Who's Who*, relating to peers, members of the House of Commons, dignitaries of the Church, Consuls, law officers and others of eminence, also a directory of clubs, schools, colleges, societies, &c. The value of the *Writers' and Artists' Year Book* is seen at once when we say that it tells the character of the articles accepted and published by principal journals and magazines. The last of the set has a large field all its own, its contents being of the kind that every woman—whether our wives, daughters or whatsoever relations—ought to know, for it tells of educational, professional and social life and philanthropic effort so completely as to form an excellent guide for every woman who wishes to know the organisations and facilities that are available to assist her to secure her way to healthy, active life, and intellectual and beneficent career. As we have said before in announcing these books, they would form an excellent New Year gift.

The Commercial Year Book of the Birmingham Chamber of Commerce, with Trade Index and Trade Mark Section. Bemrose and Sons, Ltd., Midland Place, Derby.—We have received a copy of the fourth edition of this volume, which is an exhaustive, classified trade index, in English and French, to Birmingham manufacturers, and contains a full account of the industries of Birmingham and district, prepared for the instruction of merchant importers and buyers in all parts of the world. There is an introduction by Mr. H. W. Sambidge, the President of the Chamber, followed by a vast amount of matter concerning British import and export trade, iron and steel consumption and production in various countries, shipping, and information of a general kind concerning foreign money, weights and measures, certificates of origin, and so forth. We understand that the Year Book has a valuable circulation in the home and foreign markets

Hazell's Annual, 1912. Edited by Hammond Hall. London: Hazell, Watson & Viney, Ltd. 3s. 6d. net.—This is a very old and well-tried friend. It has reached its twenty-seventh annual issue, and this edition is revised to November 25th, 1911. It claims to give the most recent and authoritative information on the topics of the day, and to be a record of the men and movements of the time. With so wide a ground to cover, a good index is essential, and the number of entries therein has consequently been again enlarged, the references alphabetically stated being over 7,000. In many respects, 1911 has been a full and remarkable year; therefore, many new articles have been added. It is impossible to even attempt to particularise the vast variety of subjects—political, scientific, trade, and so forth—that are covered by different writers; indeed, it should not be necessary in the case of so well known a work. Electrical and engineering progress are briefly reviewed, as are also scientific progress, telephone statistics, motors and motoring, tramways and railways.

The Law of Contracts. By D. Aikenhead Stroud, LL.B. London: H. Alabaster, Gatehouse & Co. 6d. net.—The author of this pamphlet should by reason of his official position in the Solicitor's Department at the G.P.O. have a very complete and special knowledge of the subject of contracts, large and small, and therefore should be recognised as an authority. The contents of this study of the matter formed a lecture delivered last year before the Institution of Post Office Electrical Engineers, the treatment being divided up into sections as follows:—Offer and acceptance; lapse and revocation; form and consideration; mistake, fraud and misrepresentation; interpretation; breach.

The "*Journal* of the Tramways and Light Railways Association" for December contains the full reports of the Board of Trade on the Lewisham and Birmingham tramway accidents, an abstract of the report by the London Traffic Board of the Board of Trade for 1911, and some Notes on Railless Traction.

Temperature Indicator Patent.—We have received from Mr. William Rudd, solicitor, of Liverpool, the following communication:—"Letters Patent No. 15,831, of 1908.—I shall be obliged if you will allow me, as solicitor for Mr. Arthur Barry, of this city, to make public the fact that the licence granted by him to George William Clarke, for the . . . manufacture of the 'Barry patent distant temperature indicator-recorder and alarm,' under the above letters patent, was cancelled as one of the terms of the settlement of an action in the Chancery of the County Palatine of Lancashire (Liverpool District) 1911, Letter B, No. 707, in which the said Arthur Barry was the plaintiff, and G. W. Clarke & Co. (Liverpool), Ltd., were the defendants. The manufacture of the above apparatus is now carried on by Distant Recorders Co., of 13, Rumford Street, Liverpool."

Meter Approved.—The Board of Trade recently approved of the single-phase A.C. induction wattmeter, type R H, submitted by the British Thomson-Houston Co., Ltd. It will be remembered that a short time ago their M H mercury ampere-hour-meter (continuous current) was also approved.

Trade Announcements.—For the convenience of their electrical customers in London, the Adams Manufacturing Co.'s London business has been transferred to Balfour House, Finsbury Pavement, London, E.C., to which address all communications regarding Adams Igranic motor-controlling apparatus should be directed. Telephone, No. 841 City; telegrams, "Admocar, London."

Messrs. Moncrieff P. Ford & Co., of Colmore Row, Birmingham, have taken more commodious premises, owing to increasing business, and from January 1st onwards, their addresses will be 12, Bromsgrove Street, and 64-65, Dean Street. A large showroom, facing into both thoroughfares, is being fitted up for the display of machine tools, &c. (both English and American), in operation.

Messrs. G. Birch & Co., of Islington Tool Works, Islington Grove, Salford, Manchester, have converted their firm into a private limited company. Mr. Ernest Hollings becomes managing director, and Mr. T. Fletcher Robinson, the manager of the old firm since the death of the founder of the firm 11 years ago, has been retained as chairman of directors.

Bankruptcy Proceedings.—Wm. Henry Howard, electrical engineer, 5, Featherstone Buildings, Holborn, lately carrying on business as "The Holborn Electrical Co."—Under this failure a sitting for his public examination was held last week before Mr. Registrar Hope at the London Bankruptcy Court. The statement of affairs disclosed liabilities £506, and assets book debts amounting to £78, but returned as irrecoverable. Questioned by Mr. G. W. Chapman, Official Receiver, the debtor stated that he commenced business in 1900 without capital, in partnership with another person, as a jobbing electrical engineer at 60, Red Lion Street, Holborn. The partner retired in 1903, and witness continued the business alone as the Holborn Electrical Co. and as Howard & Co., successively at 18, Red Lion Street; 49, Lamb's Conduit Street; 1, New Oxford Street; 5, Featherstone Buildings; 64, Red Lion Street; and again at 5, Featherstone Buildings. About three years ago he sued the landlord of 1, New Oxford Street, for damages for trespass in connection with repairs to the roof of the building, but judgment was given against him. During the course of the action, his business fell away, as he could not give it proper attention, and he eventually closed it in April, 1911. He had since been employed as a canvasser for an electrical supply company. In 1909, his solicitor obtained judgment against him for the costs of the action, and also, in May last, an order for payment by instalments of £2 a month. Witness was unable to pay the instalments, and on committal proceedings being started, he filed his petition and obtained a receiving order on November 1st. Witness attributed his failure to want of capital, to the general falling away of business during the last three years, owing to competition by the electrical supply authorities, and to the adverse result of the action before mentioned, with the consequent liability for costs. The examination was concluded.

W. R. N. Gard, electrician, 65, Kingsley Avenue, Ealing, late Orchard Electrical Works, Orchard Street, Canterbury.—The adjourned public examination was held at the Court House, Half Acre, Bradford, on Tuesday last week. The ranking liabilities were put at £283, and the assets were estimated to produce £5. The failure was attributed to want of capital and bad trade. Debtor said he had expected to meet his liabilities from future earnings as a telephonic engineer. He admitted that he first became aware of his position in 1906, and he stated that £98 of his unsecured liabilities were due in respect of loans made between 1905 and 1909, the balance being in respect of trade debts. The examination was closed.

Bertram Newman (trading as B. Newman & Co.), 4, Cranbrook Road, Ilford, Essex, electrician.—The receiving order herein was made on a creditor's petition, and according to the accounts filed, the gross liabilities amount to £1,072, of which £853 is expected to rank for dividend, and the assets are estimated to produce £3 16s., leaving a deficiency of £849. It appears that the debtor started trading in April, 1908, in partnership with another, trading as Ward and Newman, at Ley Street, Ilford, his father purchasing a share in the business for him for £60. In October, 1908, the partnership was dissolved, and the liabilities were discharged, and the debtor started trading at 4, Cranbrook Road, Ilford, for which purpose he borrowed £100, about £50 of which has been repaid. Debtor executed a deed of assignment in April, 1910, to secure a composition of 20s. in the £ to his creditors. The composition is stated to have been duly paid. Two creditors had obtained judgment against the debtor and two others were suing him at the date of the receiving order. About the end of August, 1911, the debtor's father distrained upon his effects at 4, Cranbrook Road, Ilford, for about £40 rent due to June 24th, and the goods were sold by public auction for £31. The failure is ascribed to bad debts, and the debtor admits knowledge of his position since July, 1911. The only book of account kept is debtors' and creditors' ledgers. The fully secured creditors hold charges on a book debt.

The B.T.-H. and Illuminating Engineering.—In order to ensure the installation and use of lamps on correct principles, the British Thomson-Houston Co. has organised an illuminating engineering department as a permanent branch of its organisation. The company has been led to take this step, through the fact that the illumination results obtained with its Mazda lamp can be multiplied when it is installed on scientific lines. Under existing conditions, the full value of the new light is seldom realised, because of want of knowledge on the part of the public of scientific illuminating principles. The lighting efficiency of the lamp is frequently materially impaired by masking it with unsuitable shades, or by the use of reflectors which distribute the light in the wrong directions. Many users of the metal-filament lamp, for instance

are clearly not aware that one of the principles of its employment is that it should be placed well above the line of vision, and its light properly diffused and reflected upon the working plane.

The new undertaking of the British Thomson-Houston Co. may be divided, broadly, into two parts. The first is purely educational, and mainly consists in placing at the disposal of architects, consulting engineers, electrical contractors and others, rules and instructions which will enable them to deal unassisted with the general lighting of interiors. Where special problems are involved, the illuminating engineering department of the company will freely afford expert assistance. These instructions have been issued by the company under the general heading, "Ready Rules for Lighting Work," and consist of simple explanations how to secure effective and efficient illumination, so as to obtain greatly improved lighting results.

The company has also produced a series of complete lighting units, composed of scientifically designed reflectors and Mazda lamps. The reflectors supplied by the company are divided into three types. The first gives a concentrated stream or focusing distribution of the light. It throws an intense light over a comparatively small area, and is adapted to the illumination of rooms or interiors having lofty ceilings. The second type, the "Extensive Reflector," distributes the light in a widespread spray with a maximum intensity at about 45° from the vertical. This class is suitable for rooms with low ceilings compared with length and breadth and analogous conditions. The third is known as the "Intensive Reflector." This gives a light distribution midway between the focusing and extensive reflectors, and is intended to illuminate uniformly interiors such as large shops, restaurants, public rooms, &c., or when the lamps are arranged in chess-board fashion on ceiling.

These three types of reflectors are considered to fill practically all requirements met with in general lighting practice. With the selection of the proper class of reflector, and the correct placing of the units as regards type and distance apart, it becomes a simple matter to secure even and economical illumination under all ordinary circumstances. The reflectors are supplied in two varieties, prismatic glass or metal, the latter having the trade name of "Mazdalux." The complete lighting unit of lamp, reflector and gallery is known as the "Mazdalier." A copy of the "Ready Rules for Lighting Work" can be had free on application to the British Thomson-Houston Co.

Dissolutions and Liquidations.—The Electrical Trust, Ltd.—This company, at meetings held at 9 and 10, Pancras Lane, E.C., has resolved to wind up voluntarily, with Mr. H. G. Ash as liquidator. Creditors must send particulars of debts, &c., to Mr. Ash, 13, Finsbury Circus, E.C., by January 31st. A meeting of creditors is called for December 29th (to-day).

Electric and General Assurance, Ltd.—This company is winding up voluntarily, with Mr. Lionel Maltby, 5, London Wall Buildings, E.C., as liquidator. A meeting of creditors is called for January 8th at 5 and 6, Bond Court, Wallbrook, E.C.—Claims should be sent to the liquidator (Mr. L. Maltby) at once.

Raworth's Traction Patents, Ltd.—This company is winding up voluntarily, with Mr. F. J. Riches, 24, Basinghall Street, E.C., as liquidator. A meeting of creditors is called for January 2nd

John Musgrave & Sons, Ltd.—A meeting of creditors will be held at the Central Hall, Acresfield, Bolton, on January 3rd.

Teleautograph Co., Ltd.—A meeting is called for January 29th, at Pinners' Hall, Austin Friars, E.C., to hear an account of the winding up from the liquidator, Mr. F. A. Bagnall.

Lancashire Electrical Co., electrical engineers, 35, Dickenson Street, Manchester, and Chorlton-on-Medlock.—Messrs. L. Bradbury and G. B. Broughton will continue the business and attend to debts, the partnership, so far as concerns Sylvester Bayliffe, having been dissolved.

Kevan Electric Co., Ltd.—January 10th is the last day for the receipt of proofs for dividend by Mr. H. de Vaux Brougham, 33, Carey Street, W.C.

The Lodge-Muirhead Wireless and General Telegraphy Syndicate, Ltd.—This syndicate is winding up voluntarily with Mr. F. L. Muirhead, Elmers End, as liquidator. A meeting of creditors will be held on January 8th, at 2, Wardrobe Place, Doctors' Commons, E.C. Creditors must send the usual particulars to Messrs. Farrar, Porter & Co., at that address, by February 14th.

Nye & Co., motor dealers, electricians, and dealers in electrical apparatus, 69, Leather Lane, and 138, Gray's Inn Road, Holborn.—Messrs. R. G. Nye and P. J. Budge have dissolved partnership. The former attends to debts and continues the business.

Calendars and Catalogues.—The Electric Construction Co., Ltd., have issued to their friends a very neat and useful little vest-pocket card and stamp case, with a diary for short engagement notes.

The North-British and Mercantile Insurance Have issued a new hanging calendar with perpetual date-cards.

Messrs. Alfred Herbert, Ltd., Coventry, have again favoured us with a copy of their clearly-printed monthly sheet calendars for 1912. Each sheet bears half-tone illustrations of the firm's machine tools. They have also issued a catalogue of over 40 pages of excellently illustrated descriptive matter regarding their automatic lathes.

Messrs. Simplex Conduits, Ltd., have sent us examples of thei pocket diaries, in two forms—as a refill, and as a bound pocket-book The diary, as we know from a year's trial, is of a most convenient form, and contains in addition to the ample memoranda section particulars and prices of the company's well-known specialities and numerous tables and data of great use to engineers and contractors.

Messrs. Hayward Tyler & Co., Ltd., of 99, Queen Victoria Street, London, E.C., have again prepared for their friends their well-known pocket diary for the coming year. As usual, there are a number of useful tables of memoranda relating to water supply, and illustrated particulars of some of their pumping and other machinery.

From Messrs. Haslam & Schontheil, Ltd., of 11, Windsor Place, Cardiff, we have received a handy engagement pad for 1912, with an artistic stamped metal design on the front cover.

From the Union Electric Co., Ltd., of Park Street, Southwark, S.E., there have come to hand several desk note-taking blocks bearing the compliments of the season. The company has also just issued a new list, No. 5,025 (16 pages), wherein are given illustrated particulars, also tabulated sizes, prices, and code-words for Union direct-current motors of from ¼ to 50 h.p.

The Universal "Big-Figur" calendar received from Messrs. W. V. Waite & Co., Ltd., 31, Queen Street, Cardiff, has daily tear-off slips indicating the date clearly in large red figures.

St. Helens Cable and Rubber Co., Ltd., Warrington.—Card showing the use of cab-tire sheathed flexible in dangerous situations, with useful data for easy remembrance on the reverse side.

Greece.—Amongst recent orders received by Messrs. J. W. Brooke & Co., Ltd., is one from the Greek Government for six sets of 25-h.p. "Brooke" marine motors, and full equipment of reverse gears, tail-shafts, propellers, &c., for revenue boats for use amongst their islands, and also for the same boats six searchlight plants, to consist of combined 4-h.p. "Brooke" motors with dynamos on cast-iron base-plates, necessary switchboards, and 6,000-c.p. projectors. Messrs. Brooke report that orders in hand at present exceed those that they have ever had in hand at one time.

LIGHTING and POWER NOTES.

Aylesbury.—The U.D.C. has decided to apply to the B. of T. for a prov. order for electric lighting without committing itself to all the details. The Council has adopted a scheme submitted by Mr. Philip Dawson.

Barking.—A L.G.B. inquiry was held on December 21st into the application from the U.D.C. for a loan of £11,000 for electricity purposes. There was opposition on the part of ratepayers, it being alleged that the loan was required "to bolster up the undertaking," and on the ground that the average price realised for energy was only 1·8d. per unit, whereas the cost of production was over 2d. per unit. For the Council, it was urged that the scheme was put forward in order to reduce the working expenses.

Blackpool.—A revised estimate of the cost of the proposed extensions to electric lighting and tramway plant necessary to meet the demands of the coming summer has been submitted; the original estimate was for £12,000, but since obtaining tenders this has been reduced by £2,000. The Finance Committee will be asked to obtain sanction for the necessary loan.

The whole length of the Promenade is to be lit with flame arc lamps; the proposal affects 140 lamps, and the cost will be £1,350.

Burnley.—A special meeting of the T.C. to consider the question of supplying electricity to Reedley Hallows was held on December 21st. Alderman Emmott said that the Salford Corporation was promoting a Bill to supply gas to outside districts, and the question of profits had been raised. Would the provisional order Burnley was seeking affect them as to profits made if they supplied an outside district with electricity? Mr. Garratt (Deputy Town Clerk) said Reedley Parish Clerk had asked certain questions, and one of these was the price at which it was proposed to supply current. He did not think the question would assume the same proportions as it had done at Salford in regard to gas. The resolution for the provisional order was carried.

Buxton.—The U.D.C. has received the sanction of the L.G.B. for loans of £280 for E.L. mains; £235 for services; and £198 for meters.

The U.D.C. has decided to support the Bill of the I.M.E.A., and to contribute up to £3 towards the costs.

Canada.—According to the *Board of Trade Journal* an extension of the street lighting system, at a cost of about £36,000, is contemplated in a town in Western Canada. It is proposed to form a company, being a merger of several existing companies, to set up power works and supply electrical energy over a large district of Nova Scotia.

The authorities of a town in Ontario propose the extension of the municipality's hydro-electric system, at a cost of about £277,700.

Doncaster.—A special meeting of the T.C. has formally approved of the memorial to the B. of T. for a provisional order in connection with the supply of electricity to Wheatley.

Douglas (Isle of Man).—The T.C. has asked the Manx Electric Co. to submit terms for a supply of current in bulk. In the meantime, steps are being taken to ascertain the probable number of consumers and the quantity of current required, together with the cost of wiring premises.

(*Continued on page* 1071.)

WORCESTER ELECTRICITY SUPPLY DEVELOPMENTS.

Having passed through many vicissitudes since its inauguration in 1894,* electricity supply in Worcester seems at length to have fallen on brighter days. In the first place, high hopes were based on the utilisation of the water power of the Rivers Severn and Teme. Opposition from the River Authority prevented the erection of a station on the Severn (which is, as a matter of fact, very unsuitable for the present purpose). A water-power station was ultimately erected at Powick (2½ miles from the centre of Worcester), and, despite inherent limitations due to summer drought and winter flood, has been much improved in later years. As is the case in so many hydro-electric undertakings, the heavy capital burden on the Powick installation remains a serious handicap on its profitable operation.

When the limiting capacity of the Powick station was reached in 1903, it was decided to erect a purely steam-driven station in Hylton Road (on the bank of the Severn, and near the centre of Worcester).† This station operates in parallel with the Powick plant, and has itself been considerably extended, now comprising seven Belliss and Morcom engines driving E.C.C. alternators and Bruce Peebles dynamos. The present general appearance of the

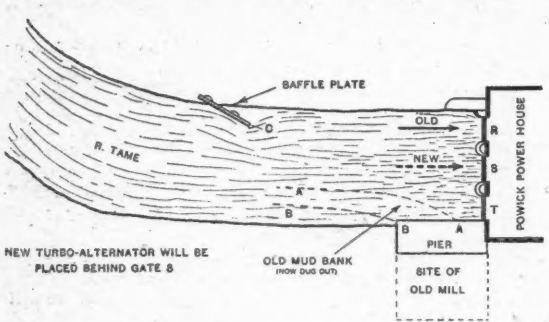


Fig. 1.—Alterations in Bed of River Teme, at Powick.

power house, containing 3,300-B.H.P. generator capacity, is shown in fig. 2.

The original Powick station contained only single-phase generators, but the mooted electric traction developments (since realised) led to the Hylton Road station being arranged for D.C. supply, with only such motor-alternator equipment and A.C. switchgear as would allow of the co-operative working of the two stations. During the past six years preparations have been made for the ultimate substitution of two-phase 50-cycle A.C. for the original single-phase, 100-cycle supply, and, with this end in view, all the station switchgear, transformers, alternators and motors installed during this period have been designed to facilitate their conversion to two-phase working at minimum expense. Additional power connections henceforward will be to the two-phase mains whenever possible. Eventually, the Powick and Hylton Road stations will supply only direct current and two-phase alternating current (50 cycles), but, for some years to come, the undertaking will also supply a large one-phase 100-cycle demand.

Such an important change in the supply system has naturally necessitated considerable alterations in the equipment of both generating stations. It is worthy of note that the whole of the alterations to buildings, construction and installation of switchgear, and alterations in, and installation of, old and new machinery, is being conducted by the department's own staff. The wisdom of such a policy, enabling, as it does, the permanent maintenance of a large skilled staff familiar with the whole equipment, is evidenced whenever alterations or extensions are to be effected.

During the past five years great improvements have been made in the river bed above and below the Powick station, with a view to increasing the total output available and the regularity of the same. At the time of the visit of our representative the alterations indicated in fig. 1 were approaching completion. Hitherto the flow of the stream has been largely concentrated on the left hand sluice R, and a mud bank had gradually formed at A A, further reducing the output obtainable at sluice T. By means of a wooden baffle plate C, projecting into the stream as shown, it is hoped to deflect the centre of flow to S, meanwhile adhering to a new batter line B B.

As the result solely of the improvements in the head and tail races, it was found possible to run one 30-in., one 48-in., and two 54-in. turbines simultaneously for the greater part of last winter at Powick. It is expected that this record will be again broken as a result of this summer's work on the river bed.

During the spring and autumn, the flow of the River Teme at Powick varies from 20,000 to 60,000 cb. ft. per minute, the average head being 10 ft. Owing to the restricted area of canal to the works and the limited power of the turbines, only 26,000 cb. ft. per minute can be utilised. Under these conditions, the output of the station reaches 3,500 B.T.U. per day. In summer, the flow of the river greatly diminishes; water is then stored during the day for use from midnight to 7.0 a.m. for public lighting and general night supply. The costs at the steam station are thus materially reduced. Under these circumstances, the mean effective head of the stream is 10 ft., and the daily output from Powick, 250 B.T.U. During the weeks of extreme flood, the Powick station is entirely shut down, but a great improvement in the output during the remainder of the flood season has been lately effected by the installation of a 70-KW. D.C. generator, which, by its wide range of field excitation, allows of the maintenance of sufficiently steady terminal voltage. With this D.C. machine there is, of course, no question of a "synchronous" speed (the necessity for which is responsible for the difficulty of operating A.C. machines by turbines subject to variable head). During the five months' flood season of 1910-11, this set increased the station output by 75,000 B.T.U.

A new turbine is soon to be installed for driving a 250-KW., two-phase, 50-cycle alternator. Provision will be made for varying the speed ratio between the turbine and alternator shafts, so as to compensate roughly for the variations in turbine speed due to alterations in the available head of water. The turbine will pass about 20,000 cb. ft. of water per min. at full load, and will have four runners arranged in two pairs, only one pair being in service at times of reduced flow. Maximum annual efficiency will thus be secured on the new equipment.

The old mill at Powick, which shared the water power with the electricity station, has now been removed and its buildings have been demolished. On its new site the mill employs 30 electric motors, totalling about 140 H.P. output.

The present equipment of the Hylton Road station includes one compound and six triple-expansion Belliss & Morcom engines (fig. 2) supplied by four B. & W. boilers, with chain-grate stokers, burning slack and small nut coal (10s. 6d. per ton), with natural or slightly forced draught.

A 125-KW., two-phase, 50-cycle alternator is to be added in the main engine room, and a second 200-KW. motor-generator will be erected in an outhouse adjoining the engine room. The latter machines, together with the 250-KW. set at Powick, will supply the two-phase load (supply for the motor-generators being taken from the lighting or traction

* Electrical Review, Vol. XXXV, pp. 441-446; Vol. XL, pp. 443-444.

† Electrical Review, Vol. LII, pp. 881-883.

bus-bars), and will be supplemented at a later date by two 400-KW. steam alternators (converted to two-phase). The motor-generators will connect the D.C. and the A.C. supply systems, balancing on the D.C. side and correcting power factor on the A.C. side.

Under the management of the city electrical engineer, Mr. C. M. Shaw, the supply of various classes of consumers has been vigorously pushed on. Though the Worcester Corporation has not joined the Joint Publicity Association, a consumers' department and a limited scheme of canvassing and general publicity have already been adopted, and with such marked success that further developments may be expected at an early date.

The City of Worcester is essentially conservative, and is certainly not a manufacturing centre. The city is market town for the surrounding country, and, though this fact is responsible for its commercial prosperity, it does not especially favour the development of electricity supply. Yet, under comparatively unfavourable conditions, extraordinary developments have recently been made, and there is every sign that still more rapid advances will be made in the near future.

In 1894 it was a matter of congratulation that the town waterworks employed two 30-B.H.P. asynchronous motors (which, by the way, are still in everyday use), but Messrs. Heenan & Froude alone are now installing 400 H.P. of motors. Most of the manufacturers in the town have adopted, or are contemplating, electric drive for their machinery; and, in all, over 200 motors (totalling over 1,000 H.P.) are in present use, while from £500 to £750 worth of power business is in immediate sight (excluding Messrs. Heenan & Froude's installation). As regards generating economy, the total station cost per B.T.U. was 1·88d. in 1905, as against 0·92d. per B.T.U. in 1911.

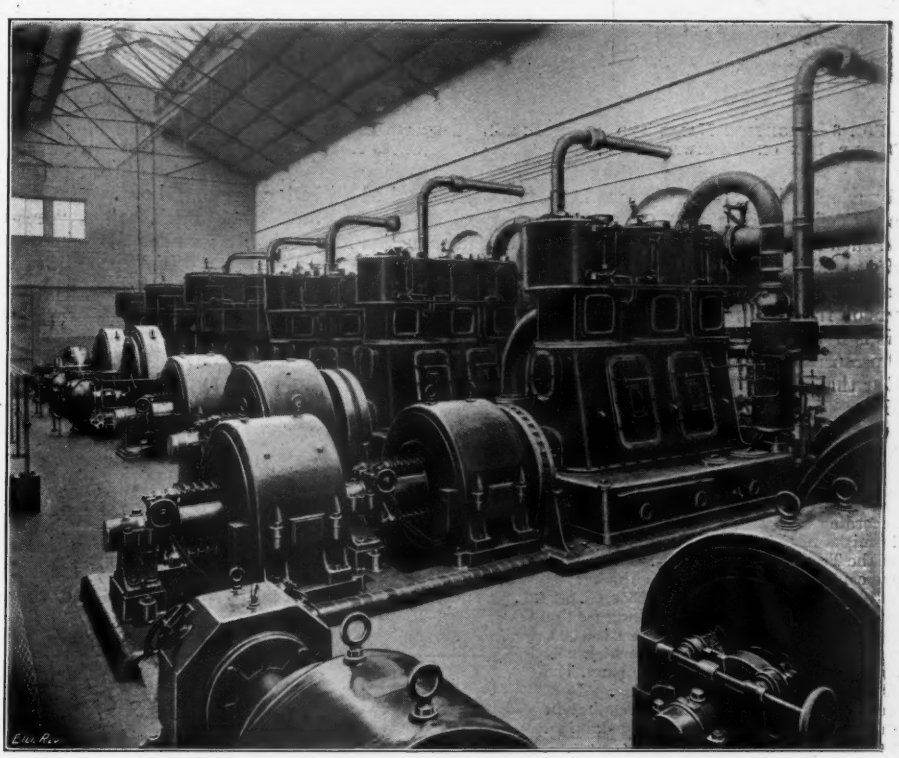


FIG. 2.—HYLTON ROAD STATION, WORCESTER: INTERIOR OF ENGINE ROOM.

As regards street lighting, the Corporation has powers to attach street lamps to the tramway company's trolley poles, and this licence is utilised to the full. A very handsome and effective type of metallic-filament lamp fitting comprises four 100-C.P. Osram lamps covered by a specially designed white enamelled reflector (three lamps are at the apices of an equilateral triangle, the fourth is placed centrally and at a slightly lower level). Arc lamps are employed for lighting the main streets of the city. Alternate poles are provided with D.C. and A.C. arcs respectively; the D.C. arcs are extinguished at midnight, but the A.C. lamps burn till dawn. So steady is the running of the latter, and so perfect the gradation of the two sets of globes, that it needs a special test to distinguish between the D.C. and A.C. arcs.

In the outskirts of the city two 50-C.P. metal-filament lamps are attached to each trolley pole, and are supplied by a bare two-wire overhead line (see fig. 3), fed from the ordinary lighting mains at various points. In the pole here illustrated, the feeder connecting box, lamp fittings and general wiring are clearly visible.

Various very neat and efficient types of street corner lamp brackets, with distributing top reflectors, are used, and a specially elaborate fitting for six 100-C.P. Osram lamps (on top of a convenience at the centre of cross roads) is illustrated in fig. 4 herewith. A life of 3,000 burning hours is frequently exceeded by the metallic-filament lamps used for street lighting in Worcester.

There are already some 12 miles of bare overhead wiring in use for street lighting on the above system, and trial is now to be made of a simple type of wooden pole carrying two wires on telephone-type insulators for the lighting supply of outlying residential districts. These poles will each carry a 50-C.P. metal-filament lamp for street lighting, and will be placed 50—60 yards apart. An earthed guard wire on the overhead line side of a 1/1 transformer will be used as a switching lead for the pole lamps, suitable groups of the latter being controlled by Venner time switches. In special cases, lamps will run all night. A 200-yard length of such a line is undergoing observation, and if the system is approved, some 10—15 miles will be erected in the near future.

In interior house wiring, surface flexible leads, carried by wooden or porcelain cleats, are often employed. High quality material is used, but no special mechanical protection is provided. The wires are finished to match their surroundings, and form an ideally cheap and inconspicuous installation. No serious mishaps have yet been attributable to this wiring system, and the construction is accepted by all the insurance companies concerned.

As regards the main supply feeders to various localities, lead-sheathed, paper-insulated cables drawn into conduits or laid in bitumen are being used for all extensions. The original high-tension single-phase mains from Powick to Hylton Road, insulated on the Brookes oil system, are still in use. The outside of the W.I. containing-pipes (which were not galvanised), is slightly pitted, but the tubes will stand for several years longer before extensive renewals become necessary. Meanwhile the only attention required is the occasional make-up of the slight oil leakage from the various section boxes.

Not the least remarkable feature of the Worcester undertaking is the fact that all the important developments noted above have been *paid for out of revenue*. Since 1905 about £9,200 has been charged to revenue for items which undoubtedly come under the heading of capital expenditure. This unusual policy is very favourable to the future prosperity of the undertaking, but it has naturally

handicapped the department during the last six years. With higher capital powers, the electricity department would have made more rapid progress, and the Corporation was only deterred from seeking extended borrowing powers through a desire to reduce the abnormal capital debt on the original works. Under the circumstances, the financial policy adopted is undoubtedly sound, though it has resulted in a net deficit to date of £777.

Fig. 3.—Lighting Mains and Feeder Box on Tramway Pole.

Fig. 4.—Special Lighting Fitting at Cross Roads.

In such an old-established undertaking, the introduction of the metallic-filament lamp was keenly felt; its effect has been about £5,000 total loss of revenue, and the temporary reversion from a hardly-won profit (in 1907) to a loss. The crisis is now past, and a period of exceptional development and prosperity lies before this historic station.

Our thanks are due to Mr. C. M. Shaw, city electrical engineer, for his kind assistance in collecting the above information.

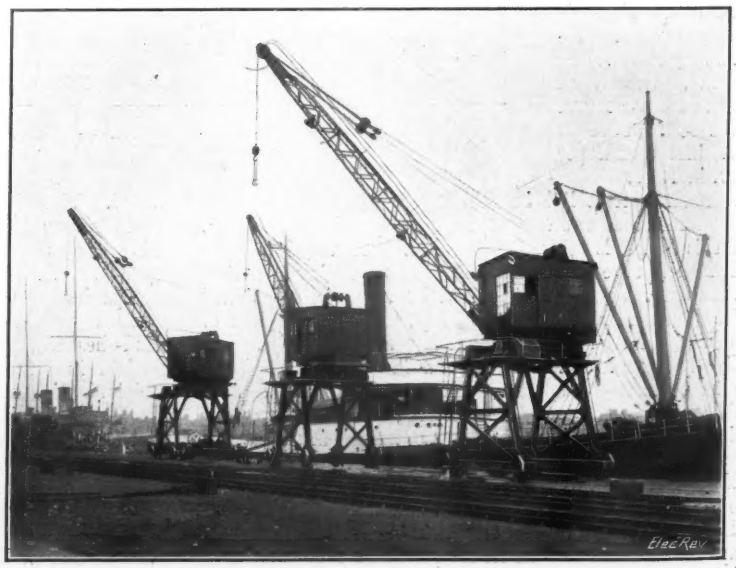
Electrometallurgical Progress in Sweden and Norway.—According to a contract with the Waterfalls Authorities, the Elektrotermiska Aktiebolag, Trollhättan, has since 1910 hired 7,000 H.P. from the Trollhättan Waterfalls. The company has now entered into a new contract for the hiring of a further 10,000 H.P. over the period from 1912 to 1940 at a fixed price of 35s. 6d. per H.P. per annum. At the same time it has been decided to increase the company's capital from £33,333 to £100,000, for which shares are to be issued, which will be taken up by the mother company, the Hydraulic Power and Smelting Co. It is intended to employ the additional capital in extending the works and the production. Large factory buildings are already in course of erection, and the work is being pressed forward with all possible speed. The whole of the production from the zinc-ore mines of Saxberget, amounting to about 10,000 tons of roasted zinc-ore per year, has already been contracted for, but as the capacity of the works after the completion of the extension will amount to 35-40,000 tons per year, the company will have to rely upon imported ore to a great extent. The Zinc Works are estimated to be capable of producing 12 to 15,000 tons of zinc, and 3,500 tons of lead per annum, when worked to their full capacity. The stipulated price of the electrical energy is very low, but in view of the fact that the Trollhättan Electrical Works at present are capable of producing more energy than they can dispose of to the industry, the contract is considered as being advantageous to both parties. The increased activity will be of great importance to the traffic of the new Trollhättan Canal, which has recently been constructed, and which connects the large lake of Venern with the sea.

At the last general meeting of the Ringerike Nickel Works in Norway, it was decided to authorise the directors to sign a contract for the delivery of the whole output of ore from the mines to the Kristiansand Electrical Refining Works. The working of the mines, which have been lying idle for years now, will be started in the spring, and electricity will be employed in the mines for most purposes. The energy is to be supplied by the Vikesunds Electrical Works.

NEW ELECTRICAL CRANE INSTALLATION AT THE GRIMSBY DOCKS.

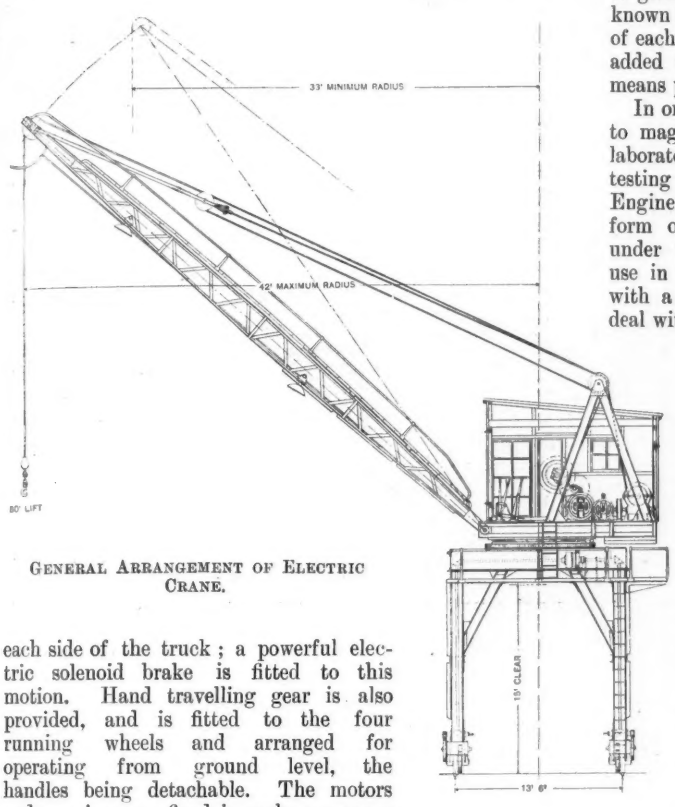
An installation comprising three 2-ton electric jib cranes has recently been provided by Messrs. Stothert & Pitt, Ltd., of Bath, on the north side of the Great Central Railway Co.'s Alexandra Dock at Grimsby. These cranes, which we illustrate in the accompanying figures, are capable of lifting 2 tons at a maximum radius of 42 ft., and are fitted with the motions of lifting, slewing, jib-derricking and travelling, each operated by a separate motor. Hand-travelling gear is also provided. The cranes are mounted on a truck 13 ft. 6 in. centres of rails, with a clear head-room between the legs of 15 ft. The speeds of the cranes are as follows:—Lifting, 2 tons at 150 ft. per minute; slewing, 2 tons at 400 ft. per minute, with jib at maximum radius; derricking, 2 tons at 50 ft. per minute; travelling without load, 50 ft. per minute. The lifting gear is of double-purchase, and the load is lifted on a single part of rope, the rope being fitted with overhauling weight and ball swivelling hook. The lifting gear is arranged on Stothert & Pitt's patent "free-barrel" system, which has previously been described in our pages. All the cranes are fitted with "Pitt's" patent overwinding gear and no-voltage release. Direct current at 460 volts is used; the lifting motor is of 30 B.H.P. at 430 R.P.M., the derricking motor 15 B.H.P. at 430 R.P.M., and both the slewing and travelling motors are of 6 B.H.P. at 550 R.P.M. The slewing motion is operated from the motor through a train of worm and spur gearing and a vertical shaft, on which is keyed a steel pinion, which engages with the externally-toothed slewing-ring fixed to the top of the gantry. The slewing-ring is of cast steel. The weight of the revolving superstructure is carried on a live ring of steel rollers bearing on top and bottom roller paths of steel.

The derricking motion is operated through a suitable train of bevel and worm gearing. The derrick barrel is in two parts, one part having right-hand and the other left-hand spiral grooves turned to suit the derrick ropes. The derrick gear is capable of adjusting the radius of the jib from 33 ft. minimum to 42 ft. maximum. A switch is provided in the driver's cabin, which is operated by a lever



Electric Cranes at Grimsby Docks.

attached near the foot of the jib, in the event of maximum or minimum radius being exceeded. The travelling motion is operated by spur and bevel gearing engaging one wheel on each side of the truck; a powerful electric solenoid brake is fitted to this motion. Hand travelling gear is also provided, and is fitted to the four running wheels and arranged for operating from ground level, the handles being detachable. The motors and gearing are fixed in such a manner that they may be easily inspected from the floor level of the cabin. A small traveller is fitted in the roof of the cabin for lifting the motors and gearing for examination and repairs.



General Arrangement of Electric Crane.

The spur gearing throughout is of cast-steel with machine-cut teeth, and the lifting and travelling motors are fitted with compressed paper pinions. The first reduction of slewing gear consists of a forged steel worm engaging with a worm wheel, having phosphor-bronze teeth, the worm running in an oil bath and being fitted with ball-bearings to take the thrust. The derrick worm gear is the same as described for the slewing.

THE USE OF ELECTRICITY IN THE TREATMENT OF MAGNETIC ORES.

There are in existence a large number of metallic ores which are more or less magnetic, and it is obviously useful, therefore, to subject these to some form of concentration, utilising their magnetic properties before subjecting them to any reducing operation, inasmuch as the cost of obtaining the pure metal from the ore will be very much lessened the higher the yield is from a given bulk of the ore put into the reducing plant. In addition to this, the use of magnetic separation is very much widened by the fact that in nature very few metalliferous ores are found in an absolutely pure state, and one of the most common impurities found is that of iron. This iron impurity, although small in quantity, is yet sufficiently affected by an intense magnetic field to enable the grains of mineral to be removed. So useful is this process, that cases are known where ores originally non-magnetic are initially treated by one of the many processes known to metallurgists, and adapted to the peculiar conditions of each particular ore, whereby an iron impurity is actually added to the ore in order to render concentration by this means possible.

Fig. 1.—Hand-operated Magnetic Separator.

In order to determine the property of an ore with respect to magnetic dressing, it has frequently been felt in the laboratory and assay office that some form of separator for testing purposes is necessary, and the Brush Electrical Engineering Co., Ltd., have placed upon the market a small form of separator, shown in fig. 1, which is designed under the patents of Mr. Marcus Ruthenburg, for hand use in testing and separating samples of ore. It is built with a gap variable from $\frac{1}{4}$ in. to $1\frac{1}{4}$ in., so that it can deal with different sizes of ore, the gap being easily adjusted by means of the hand-wheel on the top. The magnetic circuit is made of soft iron of high permeability, and is excited by a winding contained inside the bowls. The standard winding is arranged in two coils, and four terminals are provided, by which the coils can be put in series for 200 volts or in parallel for 100 volts. The winding can, however, be arranged for any voltage required up to 500 volts. As the separator is only of small size, and it is desirable to have as strong a field as possible, the windings are only suitable for intermittent use, and are not intended to be in circuit for longer than 30 minutes at a time, on account of overheating. It is often necessary to have a weak field when separating ores which are strongly magnetic, and for this purpose a regulator is required for use in series with the winding. This regulator is provided with about 20 steps, so that different strengths of field can be obtained. The weight of the whole outfit is only 160 lb., and it measures 1 ft. 8 in. high × 1 ft. over the largest diameter. The power taken by the exciting winding is 1 kw.

It would be tedious to enumerate all the separations which have been made by this simple apparatus, but among them may be mentioned the withdrawal of low-grade black-band iron ore from slate piles without grinding. Iron ores containing copper and sulphur have been separated, the recovered

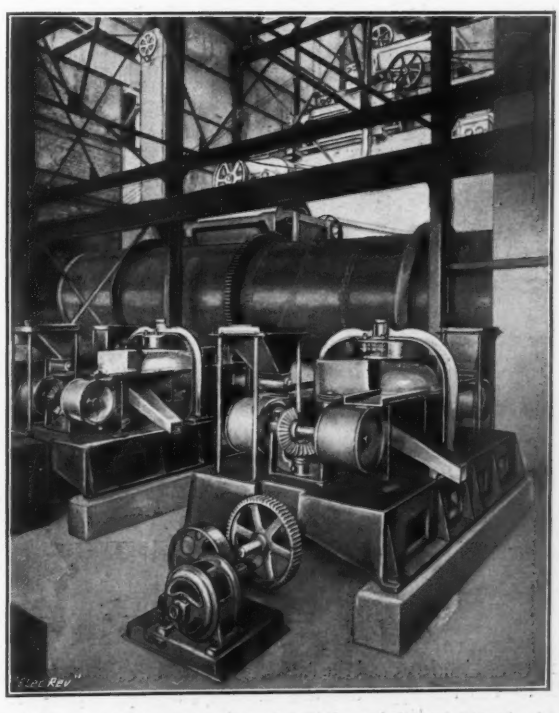


Fig. 2.—Magnetic Separators at a Cornish Mine.

copper paying for the work; manganiferous iron ore has been separated into high manganese and iron ore low in manganese, the separation of tin from monazite sands and from spathic iron has been effected, and there have been interesting cases where copper, antimony and silver in iron and manganese were separated into antimonial copper carrying silver, and manganiferous iron ore. In addition to these small experimental plants, larger sizes of separator have been built for continuous operation under commercial working conditions, and figs. 2 and 3 are interesting as showing some large separating plants on this principle erected in Cornwall.

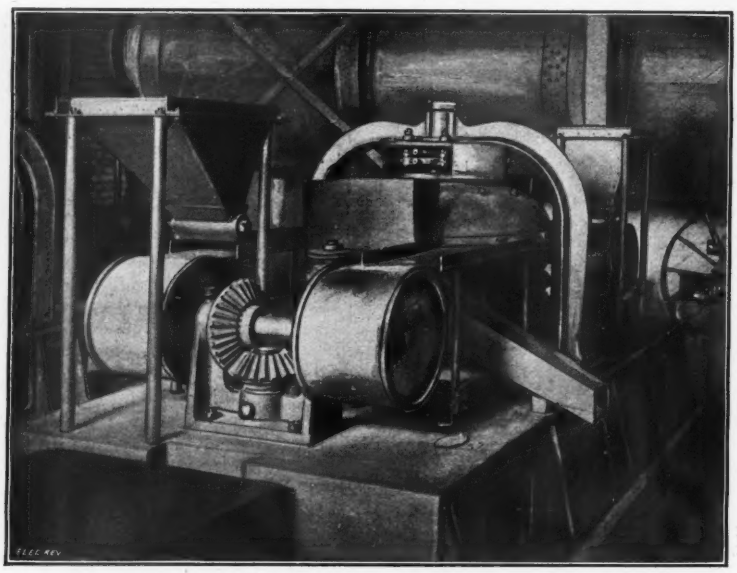


Fig. 3.—Ruthenburg Ore Separator.

The mill is terraced on a hill side. The crude ore as mined is delivered at the top to a rock breaker, breaking to an inch cube, followed by a ring screen set to 30 mesh. Fifteen per cent. of the weight of the original ore being small enough is passed by this screen, saving the subsequent handling of this amount.

The oversize flows by gravity to a pair of motor-driven rolls which are set to $\frac{1}{4}$ in., the product going to a second ring screen set to 30 mesh which passes 45 per cent. of the ore as small enough. The oversize goes to the second rolls, also motor-driven. These rolls are set close and reduce the last of the ore to 30 mesh. All of the screenings are combined and fed to a revolving roaster (seen in fig. 2), in which they are given a flash roast, making all ferruginous particles magnetic. The roasted ore is then cooled and fed to the magnetic separators, where every grain having the least iron in it is picked out. The concentrates are sold to the smelter. The equipment illustrated does the work of 80 California stamps with half the expenditure of power. The compactness and ease of observation and adjustment of this plant will be apparent.

The mode of operation of the apparatus is indicated in fig. 4. The double mushroom magnet A is mounted on a vertical spindle B, running in suitable bearings, and has a central core, round which is wound the exciting coil C. The magnetic field is used in the gap round the periphery, the upper pole-piece A^2 being bevelled to concentrate the field, while the lower pole-piece A^3 is left flat. A channel D of non-magnetic material is secured by flanges to the inside of the pole-pieces, and annular brackets E of the same material are bolted to the outside. Pulleys G carry belts H, which convey the crushed ore between the pole-pieces; the magnetic particles are attracted, and adhere to the upper pole-piece, whence they are swept off by the rope M, which is driven faster than the mushroom magnet, and fall into a receptacle N, while the unattracted particles are carried away by the belts and fall into receptacles K.

It will be seen that magnetic separation under the Ruthenburg patents has reached a pitch of perfection which removes it from the category of experimental work, into the class of standard mining operation. Magnetic machines for treating ores are generally described as separators, and not as concentrators, for the reason that they are usually used for a secondary dressing of a concentrate previously made by other means. This is not a case of necessity, and sometimes not of expediency. Especially is this a wasteful practice if the ore slimes, as in the case of copper or lead, and the slimes float, causing a heavy loss of the mineral of greatest value. In dealing also with tin and wolfram ore, much of the wolfram slimes, and is lost in the washing. In any of these cases, if the magnetic machine were used (assuming, of course, that the ore was amenable), much better recoveries would be made, as slimes are magnetically recovered as easily as the larger particles.

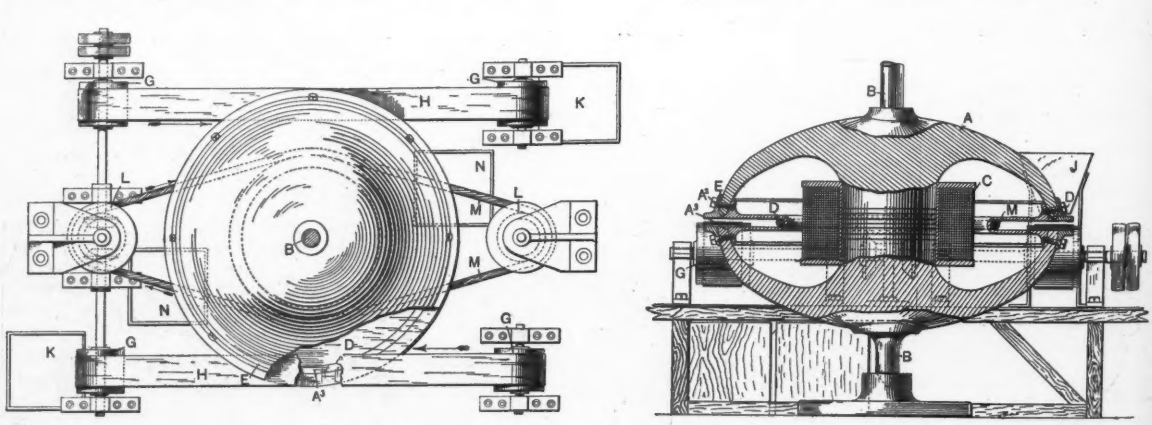


Fig. 4.—Details of Ruthenburg Magnetic Separator.

Haslingden Electricity Supply.—The Corporation supply was inaugurated on the 19th inst. Energy is taken in bulk from Accrington Corporation and distributed to the tramway, &c., from the Prinny Hill Station. Councillor Waddington, chairman of the Electricity Committee, switched on the current, and reference was made to the fact that the Corporation got its first provisional order for electric lighting so far back as 1896. Councillor Waddington entertained the members of the Council to a banquet, at which the Mayor presented him with an electric candelabrum, in recognition of his services in connection with the question of electricity supply.

LIGHTING and POWER NOTES.

(*Continued from page* 1065.)

Chester.—At a meeting of the Council on the 20th inst., Alderman Hewitt moved that the Refuse Destructor Committee, whose recommendations have caused much controversy in the city, consider the advisability of suggesting to the Electricity Committee the erection of a joint electricity and destructor works. They had been told authoritatively that to separate the destructor from the electricity works was to saddle the ratepayers for at least 30 years with an annual expenditure of £1,000. The Council on several occasions had voted the question of the destructor being placed on the present site of the electricity works, as the present electricity works included about £18,000 worth of buildings, and a large expenditure would be necessary for the removal of the buildings and plant. Since 1900 they had trebled the consumers and more than doubled the output of electricity, having spent on an average £1,000 a year on new buildings. If Hoole came within the city boundary, they would have to spend a great deal more on their electrical undertaking, and would require a larger building or another station. The motion was adopted.

Continental Notes.—BELGIUM.—La Société des Charbonnage de Corvette-Rufin is about to establish an electricity generating plant in connection with its collieries at Beyne-Hensay.

Excellent progress is being made with the adoption of electric driving at the steel rolling mills of the Société Metallurgique d'Esperance-Longdoz, at Longdoz. All the rolling mills except one are now electrically equipped, and the last steam engine will be displaced next month. The necessary electrical energy is supplied from the company's own plant at Seraing.

RUSSIA.—H.M. Consul at Riga reports that the municipalities of Pernau and Wenden have been authorised to raise loans for the installation of electric lighting.

Greenock.—At the last meeting of the T.C. it was reported that the output from the Corporation's electricity works had reached a total of one million units for the month, this being 61 per cent. higher than for the same period last year. Notwithstanding an average expenditure of £15,000 annually in improvements and new machinery, the works were at present taxed to their utmost capacity.

The Corporation has decided to approach the Secretary for Scotland with a view to obtaining borrowing powers for £20,000 for the extension of the electricity works.

Guildford.—The B. of G. has rejected the recommendation of a Committee that the workhouse should be lighted by electricity. The electricity company offered to light the institution for £297, and to spread the cost of the installation (£600) over 10 years, free of interest. The gas company's offer was £312 per annum for lighting.

Holmfirth (near Huddersfield).—By 10 votes to 7 the U.D.C. at a special meeting has decided to apply to the B. of T. for a prov. order to generate and supply electrical energy within the urban districts of Holmfirth and Netherthong.

Hornsey.—At the last meeting of the Council, it was decided to carry out extensions to plant at the electricity works at an estimated cost of £8,941, and application is to be made to the L.G.B. for sanction to the borrowing thereof. This amount includes a new 750-KW. steam set and condenser, £4,900; cooling tower and pipes for same, £950; switchboards, cables, &c., £1,196; water and steam piping, &c., £820. In moving the adoption of the report, the chairman of the Electricity Supply Committee stated it would be about nine months before some of the machinery could be delivered. This expenditure was not of a speculative character, but was forced upon them by the exigencies of the growing load. It was further decided at the meeting to support the Bill of the Metropolitan Electric Tramways Co., and the Middlesex County Council is to be asked to invite the District Councils of Tottenham, Wood Green, Friern Barnet, Southgate, Edmonton, Enfield and Finchley and the directors of the Great Northern and City and Great Northern and Piccadilly Tube Railways to support such Bill.

Horsham.—The annual report of the electrical engineer, just published, contains the following:—"The reduced running costs, and the increased output have had an excellent effect upon our finance, the year's working having resulted in a net profit of £314, against £41 for the previous year. The gross profit of £2,345 represents a return of just over 7 per cent. on the capital expended."

Ipswich.—The T.C. has decided to apply to the L.G.B. for a loan of £9,130 for the provision of additional plant, viz., steam turbine, dynamos, &c., £4,881; foundations, £300; extension of main switchboard, switches for pump motors, connections, &c., £490; boiler, £2,200; pipe work, water softening plant, &c., £759; contingencies, £500.

Lancaster.—The Corporation has decided that electricity be supplied for lighting purposes to consumers of current for motive power at 2½d. per unit (less 5 per cent.) between the hours of 11 p.m. and sunset on the following day (a charge of 3s. 6d. per meter to be made for each quarter), the number of units allowed on the above basis not to exceed 10 per cent. of the units used for power. Consideration of the revision of the charges for current for lighting purposes has been deferred for the present.

Linlithgow.—The application for a provisional order for the purposes of supplying electric light in the parishes of Linlithgow, Bo'ness and Carriden, Bathgate and Torpichen, was considered by the County Council at its last meeting. The Council, after hearing the report of the sub-committee appointed to consider the proposal, while withholding its consent meanwhile, agreed to the passing of the order, provided the promoter agreed to insert the same protective clauses which were included in the order granted to the Scottish Central Electric Power Co. in 1903.

London.—POPLAR.—The Electricity Committee has decided to transfer the two existing 500-KW. motor converters at the generating station to the Millwall and Glengall Road sub-stations at an estimated cost of £100, also to install two 1,000-KW. converters at the above sub-stations at an estimated cost of £5,000, and tenders are to be invited for the supply and erection of the converters and necessary switchgear.

In connection with the experimental installation of three types of arc lamps recently placed in Bow Road and East India Dock Road with a view to improvements in public lighting, the Committee recommends that 77 "Angold" magazine flame arc lamps should be erected. The Committee further reports regarding the extension of plant at the generating station, which was reported upon to the Council, when the mutual standby of the Poplar and Stepney undertakings was approved in September last. The present load on the Council's station, estimated at 4,120 KW. when negotiations were proceeding with Stepney on the subject of this second extension, had already reached 4,440 KW., while the effective capacity of the plant installed and on order, assuming one 3,000-KW. set being out of commission, would be only 4,200 KW., with a maximum overload, under the most favourable conditions, of 600 KW. Stepney B.C. could not guarantee a standby during the winter 1912-3, and it was anticipated the load demanded at the generating station would, at that time, exceed 5,200 KW., being 1,000 KW. in excess of the effective capacity of the plant installed and on order. Negotiations for further standby and bulk supplies to be afforded to neighbouring electricity undertakings, were also proceeding. Under these circumstances, it would be necessary to at once proceed to make arrangements for the provision of an additional 3,000-KW. set to be installed before the winter of 1912-13. The estimated cost of the proposed extension is £21,171, made up as follows:—Engine room plant, £8,316; boiler house plant, £8,880; pump room plant, £350; pumping station plant, £600; coal-handling plant, £2,000; switchgear, £1,025. The proposed extension includes the provision of coal-handling plant for conveying coal by mechanical means from barge at Limehouse Cut into the generating station. Provision was made, the Committee further states, in the contract with Messrs. Willans & Robinson for the supply of a duplicate 3,000-KW. turbo-alternator and condenser, if required, at the amount of the contract for similar plant now on order, viz., £7,581, and it recommends that a further order should now be placed with that firm at the sum mentioned, less prices of spare parts not required, and that the proposed extensions, to cost £21,171, should be approved. At the meeting on the 21st inst. these three proposals were agreed to with the exception of the last, which was not moved owing to the Finance Committee deferring the consideration of submitting an estimate.

WILLESDEN.—A contract is to be entered into with the Aron Electricity Meter Co., Ltd., for the quarterly inspecting and testing of the bulk supply meters for the sum of £15 per annum on a six years' contract.

ST. PANCRAS.—Sanction has been received to the borrowing of £9,964 for electric lighting. Instructions are to be given for the preparation of a priced inventory of the Council's electrical machinery, plant, and instruments, as required by the district auditor.

Macclesfield.—The B. of G. has decided to have the new mental wards lit by electricity generated on the premises.

Manchester.—The L. and N.W. Railway Co.'s Exchange Station, Manchester, which is really situated in Salford, is now electrically lighted, current being supplied by the Manchester Corporation.

Mansfield.—The B. of G. has appointed a Committee to consider the advisability of installing an E.L. plant at the workhouse infirmary. A scheme, with an estimate of the cost, is to be prepared by the Board's architects.

Oldham.—The Corporation Electricity Committee has decided to apply to the L.G.B. for a loan of £19,567, made up as follows:—Turbine, condensers, water pipes and foundations, £6,424; switchboard extension and cables, £544; superheaters, £1,571; mechanical stokers, £2,028; mains extensions (three years), £8,000; three years' other expenditure, £1,000.

Pontypool.—The U.D.C. has decided to improve the public lighting by erecting 10 new 4,000-C.P. arc lamps, the annual cost of which will be £14 each.

Port Glasgow.—The T.C. has appointed an expert to advise as to the cost of installing an electricity station and the rate at which electricity could be supplied therefrom.

Ramsbottom.—The Lancashire Electric Power Co. has applied to the B. of T. for permission to use overhead lines for the transmission of current at a pressure of 230 volts for the purpose of supplying electricity in the urban area of Ramsbottom.

Salford.—The B. of G. has appointed Messrs. Lacey and Sillar to advise the Infirmary Committee, and to submit a scheme for lighting the infirmary by electricity, at a fee of 20 guineas.

Southend-on-Sea.—The T.C. has instructed the electrical engineer to report on the application of the Leigh U.D.C. for a supply of current in bulk.

Stoke-on-Trent.—The T.C. has decided to contribute up to £25 towards the cost of the promotion of the Bill of the I.M.E.A.

Wellingborough.—The R.D.C. last week unanimously decided to assent to the prov. order for E.L. which is being applied for by the Rushden and District E.L. Co.

TRAMWAY and RAILWAY NOTES.

Adlington.—At a meeting of the D.C. on December 20th a communication was received from the solicitors for the Preston, Chorley and Horwich Tramways Bill, stating that the company was applying for an extension of time for the completion of the tramway, &c. The Council assented to the proposed application to Parliament.

Airdrie.—At a special meeting of the T.C., the Provost called attention to the prov. order being applied for by the County Council to take over and extend the Lanarkshire tramways. It was agreed to ask the promoters to include in the Order an extension of the line from Lanehope Road, near Holytown, to Airdrie, and thereby tap a very populous district.

Baildon.—The U.D.C. has had under consideration a report on the conference between representatives of the Council and the Tramways Committee of the Bradford Corporation, in reference to a proposed tramway service for Baildon. It is estimated that the cost of the line, &c., would be about £10,500. Two schemes were presented, viz.:—(1) That the Baildon authority should obtain the running powers and lease the line to Bradford; (2) that the Corporation should construct the line and find the capital for everything. The latter scheme was the more favoured by the Baildon representatives, and it was suggested that in case of this proposal being adopted it would be necessary for Baildon either to contribute in money or else make concessions in the way of freedom from liability to district rate.

Belfast.—The position of affairs in regard to the financial deal between the Corporation and the Cavehill and Whitewell Tramways Co. practically remains where it was before reference to the arbitrator, after the proceedings in the King's Bench Division, Dublin, which resulted in the Court remitting the matter to Mr. Macassey, with the direction that he should find the value upon the basis that the undertaking was a going concern and a rent-producing undertaking. In brief, the situation now is that the arbitrator has confirmed his original award of £56,155 as the price to be paid for the undertaking, and the Corporation is advised by the Law Committee to take the opinion of counsel with a view to contesting the matter further. In other words, there is every prospect of another legal battle over the Cavehill tramways. A specially-summoned meeting of the Law Committee, to consider the matter of the amended award, was held last week in the City Hall. The meeting was a prolonged one, and no official report was supplied to the Press. We understand, however, that it was decided to "take up" the amended award on payment of the usual fees from Messrs. R. E. M'Lean & Sons, solicitors for the arbitrator. It is stated that, in the meantime, the award will be submitted to Mr. Balfour Browne, K.C., and Mr. S. Ronan, K.C., for the purpose of obtaining their joint opinion. It was felt by a number of the members of the Committee that the arbitrator had not, in his present award, paid due regard to the evidence given on behalf of the Corporation at the last hearing. It is erroneously stated by a contemporary, in reference to the deputation sent across to London by the Corporation, that "the arbitration decided to hear no further evidence." The fact is that the Cavehill and Whitewell Tramways Co. decided not to offer any further evidence.

Continental Notes.—Russia.—The Ministries of Finance and Ways and Communications have submitted to the Council of Ministers an application for the formation of a company, entitled the "Moscow-Podolsk Electric Railway Co.," for the construction and working of an electric railway from Moscow to Podolsk. The line will have a length of 37 miles, and the cost of construction is estimated at about £790,000, one-third of which will be in share capital, and the remainder in debentures.—*Board of Trade Journal.*

Sweden.—The Swedish postal authorities are at present making some trials in Stockholm with an electric motor mail van.

Dewsbury.—The T.C. has confirmed the proposal that application be made to the B. of T. for a provisional order authorising the construction of tramways in Halifax Road and along Willans Road to Staincliffe Road as far as the borough boundary.

Glasgow.—Councillor Roderick Scott has given notice that he will propose the following at the next meeting of the T.C.:—"That it be an instruction to the Tramway Committee to experiment with larger cars, either of the bogie or corridor type, carrying over 100 passengers, or probably double the number carried at present, with one motorman and two guards (one for looking after the passengers, stopping and starting the car, and one for collecting the fares), so as to ensure the success of the present experiment of two ½d. stages for one ½d."

Hurst (near Ashton-under-Lyne).—A Sub-Committee has been appointed to deal with the lease of the tramways.

Lancaster.—At a meeting of the T.C. held on the 20th inst., it was decided to cease the running of the electric cars between January 1st and April, on Sundays, the reason assigned being that the traffic did not meet the cost of current.

Llanelly.—With only three exceptions the whole of the tramway men at Llanelly went out on strike on the morning of the 21st. The men selected the season when the traffic should be at its heaviest. They belong to the Dockers' Union, and the cause of the strike is the non-recognition of the Union, and the alleged treatment of some of the men by the officials. The Dockers' Union asked the company to recognise the Union so that an endeavour might be made to avert a stoppage, but the company refused to do so. The strike is causing great inconvenience in the town and district. The company has issued a notice that it would be able to carry on only a limited service during daylight, as the police were unable to guarantee protection to the line or to the officials.

Manchester.—As the result of a poll amongst the car cleaners employed by the Corporation Tramways Committee, it has been decided to adopt the rotation system for dealing with the night work. At the present time two-thirds of the cleaners are perpetually on night work. As soon as possible this will be changed, so that each man will now do two weeks' night work and one week on day work. Between 300 and 400 men will be affected by the change.

Nottingham.—The whole of the Corporation's tramway service was suspended on Christmas Day so that every employé might have a holiday. The stoppage of electric cars means a loss in revenue to the Corporation of over £500. For the football match between Notts, County and Manchester City, enthusiasts had to use taxi-cabs, charabancs, and even costers' barrows.

Preston.—It has been decided by the Tramways Committee to purchase three additional cars, and to extend the car shed, the estimated cost being £3,000. The Tramways Committee has declined a request by Preston Trades Council asking for a public inquiry into certain statements alleged to have been made by the chairman of the Committee. At the same time it is prepared to receive a deputation on the question.

Rossendale.—The year 1911 has been an eventful one, electrically speaking, for Rossendale Valley, having witnessed the opening of the new electric car service between Bacup and Rochdale, a distance of seven miles, also the inauguration of the electric supply in Bacup, the Corporation taking current from the Rawtenstall Corporation, while Haslingden has just celebrated the commencement of the electricity supply in the borough, Accrington Corporation supplying the current. Bacup is now linked with Rawtenstall and Accrington and also with Rochdale by electric car service, and all routes are well patronised and appreciated.

Salford.—The Tramways Committee has recommended the purchase of 20 top-covers for the bogie cars. This is in response to a request from many of the regular travellers on the Salford system, the covered cars now in use being highly appreciated.

Tynemouth.—The Parliamentary Committee of the T.C. has received a letter from the secretary of the Tynemouth Electric Traction Co., stating that the directors could not accept the conditions of the Council as to the suggested extension of the system by railless trolley cars, but that any modified proposals which the Council might submit on the matter would receive the company's consideration. The town clerk was instructed to communicate with the company and state that the Committee would be prepared to reconsider the question of road widenings, but that the company must take the other conditions of the Council as final.

CONTRACTS OPEN and CLOSED.

OPEN.

Australia.—N.S.W. Government Railways.—January 8th.—Four 1,000-kw. rotary converter units. January 22nd.—Supply and erection at the White Bay power house, Sydney, of eight water-tube boilers, with superheaters, economisers and mechanical stokers. January 29th.—A 25-kw. booster set. Particulars, Electrical Engineer's Office, 61, Hunter Street, Sydney.

January 9th.—Accumulators, booster, switchboard and accessories, for the Sublaco Council. Town Clerk's office. Deposit of £100.

MELBOURNE.—January 9th. Three tons of bare hard-drawn copper cable, for the City Council. See "Official Notices" December 22nd.

Austria-Hungary. — January 20th. The time for receipt of tenders for the electric lighting of Bjelina, Bosnia, has been extended to January 20th. Conditions of tender at Board of Trade Commercial Intelligence Department, London. Tenders to the Stadtmajistrat, Bjelina, Bosnia.—*Board of Trade Journal.*

Belgium.—January 9th. The municipal authorities of Ghent are inviting tenders for the supply and installation of a new steam turbine and alternator at the central electric lighting station in the town.

Birmingham.—January 8th. (*a*) Supply, delivery and erection of 50 electric tramway cars; (*b*) 1,700 tons of improved steel girder rails, and 3,500 pairs of fishplates. Mr. A. Baker, general manager, Tramway Offices, Corporation Street, Birmingham.

Dartford. — January 23rd. One high-speed vertical uniflow engine, tandem generators and three-wire balancer, three superheaters and extensions to pipework, switchboard and electrically-driven centrifugal pump, for the U.D.C. See "Official Notices" December 15th.

Dublin.—January 30th. Dublin Port and Docks Board. Two 4-ton electric portal wharf cranes. Specification, £1 returnable, from Sir J. P. Griffith, Engineer to the Board, East Wall, Dublin.

Edinburgh.—The Governors of George Heriot's Trust invite tenders for the electric lighting and power installation in the science laboratories now under construction at George Heriot's School. Mr. John Anderson, superintendent of works, Heriot Trust offices, York Place, Edinburgh.

France.—January 5th. The French Post and Telegraph authorities in Paris are inviting tenders for a multiple telephone board for the Central Telephone Exchange.

Hornsey.—January 11th. One steam dynamo set (either reciprocating or turbine), for the T.C. See "Official Notices" December 8th.

London.—HAMMERSMITH.—January 10th. Arc lamps for the B.C. See "Official Notices" to-day.

Manchester.—January 9th. (*a*) Steel girder tramway rails; (*b*) steel tie-bars for tramway rails. For (*a*) deposit of £1 1s. required. Specifications and forms of tender from Mr. J. M. McElroy, general manager Corporation Tramways.

New Zealand. — March 7th. Napier Corporation. (1) Permanent way, overhead work and supply mains; (2) power station, car-shed and repair-shop equipments; (3) rolling stock. Deposit 2½ per cent. Specifications can be seen at the Board of Trade Commercial Intelligence Branch in London.

Radcliffe.—January 13th. Electrically-driven centrifugal or turbine pump for the U.D.C.'s sewage disposal works. W. L. Rothwell, surveyor.

Rotherham. — January 10th. One 500-KW. rotary converter, for the Corporation. See "Official Notices" to-day.

Siam.—BANGKOK. March 15th. Tenders are invited for the supply and erection of an electric power station with a capacity of 3,000 KW. Tenders, on the prescribed forms, to the Ministry of Local Government, Bangkok. For further particulars see this column for November 24th.

Slough.—January 3rd. Public lighting for a year, for the U.D.C. Surveyor, 4, William Street.

Spain.—Tenders have just been invited by the municipal authorities of Cenicientos (province of Madrid) for the concession for the electric lighting of the town during a period of 15 years.

Swansea. — January 6th. Water-tube boilers, superheaters and mechanical stokers, for the Corporation Electricity Department. See "Official Notices" December 15th.

Turkey.—Tenders will be received at the "Ministère des Travaux Publics," Constantinople, up to 2 p.m. on February 20th, for a concession for the supply of electric light and power to the town of Adalia, which has a population of some 30,000. For particulars see this column December 22nd.

Walthamstow.—Tenders are to be invited for doubling the tramway track at the "Bell" Corner, Forest Road.

West Hartlepool.—January 2nd. 191 tons steel rails, 3 tons fish plates, 11 pairs manganese cast-steel spring points (12 ft. long), 11 crossings, and reconstruction of tramway permanent way (Park route), for the T.C. Mr. N. F. Dennis, borough engineer (returnable deposit £1 1s. for each contract).

CLOSED.

Australia.—The *Australian Mining Standard* announces the placing of the following Commonwealth contracts:—

VICTORIA.—Postmaster-General's Department:—
60,000 porcelain insulators, £475.—Western Electric Co. (Australia), Ltd.
36,000 earthenware conduits, £4,202.—George Sweet.
8,500 galvanised-steel spindles, £425.—Williams & Co.
Supply of Robertson carbon-filament and Osram lamps, total £331.—British General Electric Co., Ltd.

WESTERN AUSTRALIA.—Postmaster-General's Department:—
5,000 zincs for gravity cell, at 1s. 1d. each.—A. W. Dobbie & Co.
Various telephone instruments and accessories.—J. Bartram & Sons Pty., Ltd.
15 tons galvanised-steel wire, at £16 11s. 6d. per ton; 90 tons hard-drawn copper wire, at £70 1s. 6d. per ton; 1 ton galvanised-iron wire, at £16 1s. 6d. per ton; 10 tons, at £11 19s. per ton.—R. Johnson, Clapham and Morris, Ltd.
Dust extractors, dessicating apparatus, also various instruments and telegraph apparatus.—Siemens Bros. & Co., Ltd. (England).
30 miles tinned-copper wire, at £3 15s. per mile; 3 miles, at £3 2s. per mile.—British Insulated and Helsby Cables, Ltd.
Telephone cable, lead-covered, paper-insulated: 2 miles, 104 pairs, at £310 per mile; 3½ miles, 78 pairs, at £231 per mile; 12 miles, 52 pairs, at £173 per mile; 6 miles, 26 pairs, at £116 per mile; 5 miles, 13 pairs, at £70 per mile; 5 miles, 4 pairs, at £31 per mile; 3 miles, at £366 per mile; 5 miles, at £25 per mile; 50 miles tinned-copper wire, at £9 17s. 6d. per mile; 25 miles ditto, at £7 17s. 6d. per mile.—W. T. Henley's Telegraph Works, Ltd.
10 tons phosphor-bronze wire, at £78 0s. 11d. per ton; 30 tons galvanised-iron wire, at £10 5s. per ton.—Geo. Wills & Co.
50,000 porcelain insulators at 4 11/12d. each, and 90,000 at 1 11/16d. each.—Dalgety and Co.

QUEENSLAND.—Postmaster-General's Department:—
Extension of common-battery main distributing framework and equipment, £411.—Western Electric Co. (Australia), Ltd.
Galvanised-iron tubular cross-arms.—Stewart & Lloyds, Ltd.

The following acceptances are announced in the *Mining and Engineering Review*:—

VICTORIA.—Postmaster-General's Department:—
One mile copper rubber-insulated wire, three-twisted conductors, £8 10s. per mile; 17 miles copper rubber-insulated wire, two-twisted conductors, £5 15s. per mile; 28 miles single bridle wire, £7 3s. 6d. per mile; 10 tons twisted pair outside distributing wire, £145 per ton; 100 miles twisted pair copper V.I.R.-insulated wire, £17 7s. 6d. per mile.—W. T. Henley's Telegraph Works Co., Ltd.
Supply and installation in working order of an automatic switchboard, together with all associated apparatus, at the Post Office, Geelong, £14,293.—Automatic Telephones (Australasia), Ltd.
One motor-generator and accumulators, complete, at the Central Telegraph Office, Melbourne, £450.—T. K. Steanes.
20,000 insulators, stoneware, £250.—The Firebrick Insulator and Pottery Co. Pty., Ltd.
Victorian Railways Department:—
Electrical staff instruments.—McKenzie & Holland, Ltd.

QUEENSLAND.—Postmaster-General's Department:—
60 miles wire, single bridle, at £5 16s. 6d. per mile.—Brabant & Co.
70 miles wire, tinned copper, No. 20 S.W.G., at £2 19s. 6d. per mile.—Armorduct Manufacturing Co., Ltd.

TASMANIA.—Postmaster-General's Department:—
Two miles cable, paper-insulated, lead-covered, £69 per mile.—Noyes Bros. Pty., Ltd.

Bristol.—The Docks Committee of the T.C. has accepted the tender of Messrs. Siemens for signal apparatus at the swing bridge at Avonmouth; and that of Messrs. J. H. Holmes & Co. for a spare armature for the granary motors.

Glasgow.—The T.C.'s Committee on Tramways, Works and Stores has recommended acceptance of the following offers:—

Brass rollers.—Chas. Henderson & Co., Ltd.
Testing transformer.—Brown, Boveri & Co., Ltd.
D.C.C. wire.—London Electric Wire Co. & Smiths, Ltd.; British Insulated and Helsby Cables, Ltd.
V.I.R. cable.—British Insulated and Helsby Cables, Ltd.

The general manager of the tramways department has been authorised to hire from the Bell Punch and Printing Co., Ltd., London, additional punches similar to those already hired from the company, at the rate of 10s. per punch per annum, inclusive of maintenance.

Ipswich.—The T.C. has placed with Messrs. Willans and Robinson, Ltd., an order for a second 1,000-KW. turbine, with dynamos and switchgear.

London. — SOUTHWARK. — The B.C. has received the following tenders for the supply and fixing of six new mechanical chain-grate stokers to the boilers at the electric light station:—

Babcock & Wilcox, Ltd.	(accepted)	£1,020
Bennis & Co., Ltd...		1,044
Underfeed Stoker Co., Ltd.		1,288

Ship Lighting.—Messrs. Siemens Bros. Dynamo Works, Ltd., have obtained the contract for the supply of tantalum traction-type lamps for ship lighting, &c., from the Royal Mail Steam Packet Co., for a period of six months, commencing January 1st, 1912.

Southend-on-Sea.—The T.C. has accepted the following tenders:—

Messrs. Ferranti, Ltd.—Traction meters on cars, £101.
Messrs. Doulton & Co., Ltd.—1,000 insulators for electric strip, 2s. 6d. each.
Messrs. Kerr, Stuart & Co.—45 tons of steel tram rails, £6 15s. per ton; fishplates and bolts, £300.

Taunton. — The T.C. has accepted the following tenders:—

Messrs. Crompton & Co.—200-K.V.A. alternator, £981.
Messrs. Hepman & Froude.—Superheater, £80.
Electric and Ordnance Accessories Co.—Induced-draught fan, £48.

FORTHCOMING EVENT.

Association of Engineers-in-Charge.—Saturday, January 6th. At St. Bride's Institute, E.C. Social. Dance.

NOTES.

Dundee Council and the Sale of Lamps, &c.—We understand that on 22nd inst. there was taken out of Court by a Joint Minute an action under which Mr. E. J. B. Lowdon, electrical engineer, Dundee, sought to interdict the Town Council of Dundee from selling electric lamps, shades or wire to private consumers. The action was settled by the town clerk giving a letter in the following terms:—

"18*th December*, 1911.

"E. J. B. Lowdon, Esq.,
"Electrical Contractor, Dundee.

"Dear Sir,—Referring to action of interdict raised at your instance as pursuer against the Lord Provost, magistrates and City Council of Dundee as defenders, I, on their behalf and on the condition that said action is taken out of Court by a joint minute, hereby undertake that the defenders shall not until statutory powers are obtained to enable them to do so sell to private consumers electric lamps, shades or wire, or in any way exceed our present statutory powers.—Yours faithfully,

"(Signed) WM. H. BLYTH MARTIN,
"*Town Clerk.*"

Institution and Lecture Notes.—ASSOCIATION OF MINING ELECTRICAL ENGINEERS.—At a meeting of the West of Scotland Branch, held last week at Glasgow, a paper was read by Mr. C. Jones, of the South Wales Branch, on "Earthing, Earth Plates and Leakage Detectors." The author maintained that the ideal leakage protective apparatus should be designed to operate instantaneously on a leakage current equal to a very small fraction of normal load current, so that it might discover leaks in their incipient stages and before an accident occurred. Discussing the subject of the earthed or insulated neutral, the author remarked that probably the most important questions were whether it was wise to use a resistance between the neutral and the earth, and what the amount of such resistance should be.

INSTITUTION OF ELECTRICAL ENGINEERS (NEWCASTLE LOCAL SECTION, STUDENTS).—Mr. Vesey Brown, chairman of the Newcastle Local Section, presided over a meeting of Students at Armstrong College on December 15th, at which it was decided to hold meetings for Students every fortnight and to arrange visits. A committee of Students was appointed. The chairman clearly explained the working of the Students' Sections in London, Manchester, and elsewhere. As regarded the proposed modifications to the Articles, he stated that advices had been received from London of the present intention of the Council that Students should not exceed the age of 27 years, and that the subscription for Students should be one guinea per annum up to their 21st birthday, and 1½ guineas afterwards. There was to be no entrance fee. A large number of engineers engaged in the district signified their intention of joining the Institution. The enthusiasm shown at this and other recent meetings by Students augurs well for the organisation of a strong and successful Students' Section in Newcastle. Those interested in this movement, who have not already obtained application forms, should communicate without delay with the honorary secretary, Mr. H. W. Clothier, Hawthorn Villas, The Green, Wallsend-on-Tyne.

INSTITUTION OF ELECTRICAL ENGINEERS (NEWCASTLE LOCAL SECTION).—The annual dinner took place on December 20th. Mr. C. S. Vesey Brown was in the chair, and over 100 guests were present, including the Deputy-Lord Mayor of Newcastle (Councillor Herbert Shaw), the Sheriff of Newcastle (Councillor C. T. Stableforth), Mr. Ferranti, Mr. Kingsbury, Prof. Louis, Prof. Thornton, Col. Saxton White and Mr. H. W. Clothier (secretary).

Prof. Henry Louis proposed "The Institution of Electrical Engineers." He said he did not think that any branch of engineering had been more affected by electricity than that of mining. He could not believe that there was anything inherently dangerous in electricity as applied to coal mining, and he certainly could not see that there was anything more dangerous in an occasional electrical spark than in a continuously blazing flame such as one had in a miner's lamp. The tendency nowadays seemed to be to take refuge in repressive legislation rather than to trust to their inventive capabilities. This was not the spirit which actuated the colliery owners about a century ago, when they were faced with the problem of using a light in coal mines. The question of long-distance transmission of power was of supreme importance, and in Mr. Ferranti they were entertaining one who had taken a leading part in this development, and had lived to see his schemes come to fruition.—The President, in reply, said that with regard to the Parliamentary Committee's proposal to exclude electricity from coal mines where naked lights were not allowed, the Institution protested; its request to be heard in the matter was granted, and it was eventually agreed that the Act should go through on a more reasonable basis. When they got electricity within the reach of all the different demands for which it was suitable, what they were doing to-day would be nothing compared with the electrical developments of the future. Referring to the affairs of the Institution, it had been represented to him that it should be kept a professional Institution, but electricity with them was not a hobby, and they were in it to make a living. The commercial side, however, had not been recognised in the past as it ought to have been. His wish was to try and improve the commercial side, because in any scheme the purely electrical engineering part was an item only. In order that the Institution might represent electrical engineering, it was necessary that it should include all who contributed to electrical work, and progress could only be made by co-operation between all sections of the industry. A large membership and the necessary funds were essential to making the Institution more useful.

Mr. J. H. Holmes proposed the toast of "The Armstrong College, Learned Societies and Other Guests," which was replied to by Col. Saxton White on behalf of the North-East Coast Institute of Shipbuilders and Engineers. Dr. Andrew Smith, replying for "The Newcastle Clinical Society," drew a parallel between his profession and that of his hosts, in that they were all children of science; he instanced the case of the Panama Canal as an example of the interaction between electrical and medical science, as it had been made possible, by the efforts of members of his profession, to bring the completion of this work in view, and to ensure that the majority of the workmen would not die.

Mr. J. E. Kingsbury proposed "The Newcastle Local Section," and pointed out that a local Section was not to be looked upon as a branch, but as being composed of a number of members of the Institution of Electrical Engineers who met together outside London for the discussion and the elucidation of difficulties. Mr. C. S. Vesey Brown replied, and said that the expeditious manner in which the initial steps towards the formation of the Students' Section had been carried through reflected great credit on their secretary, Mr. Clothier, who had been instrumental in having the age limit raised to 27. He suggested that many difficulties regarding the new Articles would not have arisen had Mr. Ferranti visited the various Sections, and delivered the speech he had heard that night. He agreed that the commercial side of the Institution was a highly important one, because selling was, perhaps, the most difficult branch of the engineering profession. So far as their own Section was concerned, it had been decided to develop the social side of the Institution, and to hold meetings in other towns in order to give members at a distance an opportunity of taking part in their discussions.

INSTITUTION OF ELECTRICAL ENGINEERS (SCOTTISH LOCAL SECTION).—At the first meeting in Edinburgh of the Scottish Local Section, last week, Prof. Baily read a paper on the equipment of the electrical engineering laboratory at the Heriot-Watt College. Recently the laboratory has been greatly enlarged, while there have been important re-arrangements. Considerable addition has also been made to the equipment.

JUNIOR INSTITUTION OF ENGINEERS.—The Presidential address by Commendatore G. Marconi, on "Engineering Considerations in Wireless Telegraphy," has been postponed from January 5th.

Sir Douglas Fox, presiding last week at the 117th award of certificates at the Crystal Palace School of Practical Engineering, said that in that school they were encouraged to obtain a general knowledge of engineering rather than to specialise. There was nothing more unwise than for a young engineer to fix his mind on one particular branch, until he had obtained a good knowledge of all the various branches, which would place him in a position to make up his mind.

Mr. Alex. Anderson, of Wishaw, recently delivered a lecture on "Electricity: Its Generation and Application to Mining," to a meeting at Larbert, under the auspices of the West of Scotland Branch of the Association of Mining Electrical Engineers.

Scottish Coast Cables.—The inhabitants of the island of Tiree have decided to appeal to the Postmaster-General for the installation of wireless telegraphy between Tiree and Tobermory. The restoration of telegraphic communication to the islands of Islay and Tiree has been seriously delayed by the recent tempestuous and unsettled weather.

Fatalities.—A miner, who was working at the coal-cutting machine at Barrdyke Colliery, Cambuslang (Summerlee Iron and Coal Co.), was killed on Friday last.

It is reported that, at the conclusion of a breaking-up party at a school at Rochester, an electrician named Whitaker suddenly died, through, it is said, coming into contact with a live wire.

A Central News dispatch from Berlin says that the explosion of an electric lamp at a picture theatre caused a panic and a rush in which two children were killed.

The Indian Visit.—An example of a modern direct-coupled petrol-driven electric generating set may be seen any evening on the Maidan, where it is employed supplying current for about 300 lights, to enable work to be carried out at night in connection with the Royal Pandal, which is now being erected. This installation was supplied and erected at a day's notice by Messrs. Pyne Hughman & Co., who are sole agents in India and Burma for the Aster Engineering Co.—*The Statesman*, Calcutta.

Faraday House.—The next term opens on January 8th, when a fresh course of instruction will be commenced. The entrance examination will be held on Friday, January 5th.

Appointments Vacant.—Commercial assistant in the Bradford Corporation electricity department (£250); temporary assistant for the Barrow-in-Furness Corporation Electricity Works (£3); assistant inspecting engineer for Provincial Cinematograph Theatres, Ltd. (£2); switchboard attendant for the Bermondsey B.C. (32s.). See our advertisement pages to-day.

Loss of the ss. Princess Patricia.—At the close of the B. of T. inquiry into the cause of the stranding of the steamer *Princess Patricia*, last week, the Court found that it could only be explained by the theory that the compass was deflected by an electric lamp in the pocket of the look-out man, who was stationed 2 or 3 ft. from the compass. On the face of things, the suggestion seems absurd; it was, however, given in evidence that the lamp when held 8 or 10 in. above the compass caused a deflection of about 8°, and at a distance of 2 ft. it deflected the needle about 4°. The effect was apparently due to the tin (*i.e.*, tinned steel) case of the lamp: obviously the magnetic effect of the lamp circuit would be insignificant—and it was not stated that the lamp was actually alight.

Arc Works Benefit Society.—Last Saturday week the annual general meeting of the members of the Arc Works Voluntary Sick Benefit Society was held in the Recreation Room, at the Arc Works, Chelmsford, Mr. A. J. Hodgson, the general manager, presiding. The report, submitted by the secretary (Mr. W. G. Bickmore), for the year showed that contributions to the general fund amounted to £210, and the donations from Messrs. Crompton and Co., Ltd., to £63, other receipts bringing up the total income to £316. The total number of sick pay days for the year was 3,545, or an average of nearly 8 days per member. There are 467 members, an increase of 17 for the year. The reserve fund stands at £103. The annual meeting of the subscribers of the Arc Works Voluntary Infirmary and Dispensary Fund followed. The income was £35, which was disbursed by donations to the local hospital and dispensary. The report of the Arc Works Benevolent Fund, which is supported entirely by Messrs. Crompton & Co., Ltd., was then read. It is intended to relieve any special cases of necessity among their employés who have done good service during the year. Grants amounting to £18 in all were distributed in weekly amounts among seven cases.

An Electro-textile Competition.—The Société Industrielle de Mulhouse (Alsace) is organising a number of competitions for 1912, amongst which is one for a new application of electricity in the bleaching, dyeing and textile printing industries.

The Telephone Transfer.—Before our next issue appears, the Post Office will be the sole telephone authority for this country, and we take this opportunity of expressing our sense of the indebtedness of the community to the directors, staff and employés of the National Telephone Co. for the splendid work which they have done in the past, in the face of innumerable difficulties, harassing restrictions, and continual and vacillating interference on the part of Parliament. That in spite of all these obstacles to progress the company has built up a magnificent business on sound financial lines, and has rendered to the public excellent service during the past 30 years, is a fact reflecting the greatest credit upon all engaged in the undertaking, and we congratulate them most heartily upon their record, whilst expressing the hope that their future, under the new *régime*, may prove, in spite of all misgivings, both prosperous and congenial.

The Association of Consulting Engineers.—We have received from the hon. secretary of the Association, Mr. A. H. Dykes, a copy of the Rules which have been drawn up by a committee appointed for that purpose. The subscription is to be one guinea per annum; there will be only one class of Member, who must be in practice as a consulting engineer, of approved standing, and a full Member of the Institution representing the particular branch of the profession in which he practises, but must not be a member of, partner in, or agent for any firm with which he may have to deal on behalf of his clients, or a director, employé or agent of any company doing engineering insurance work, and must not be connected with any concern that advertises or canvasses for consulting work. A member is forbidden to accept trade commissions or any indirect profit in connection with his professional work, to have any financial interest in firms with which he may have to deal on behalf of his clients without disclosing the fact in writing, to receive any royalty on patented articles or processes used on work done for his clients without authority from them in writing, to be the medium of payments except at the request of a client, to accept work in connection with which another Member has been appointed, to advertise or answer advertisements for consulting work, to solicit or pay commission for work, or to do anything which prejudices his position as a consulting engineer. New members are elected by the Committee after notice of their nomination has been given to all the Members. Each candidate must be supported by four Members of the Institution to which he belongs. Members who break the Rules are liable to expulsion, after an opportunity for explanation has been given.

The formation of the Association will be celebrated by a dinner in January.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station Officials.—The Bridlington T.C. has, by 11 votes to 7, referred back to the Electricity Committee a recommendation that the salary of MR. A. J. BECKETT, borough electrical engineer, should be increased by five annual instalments of £20 each from January 1st, from £300 to £400 per annum, on Mr. Beckett agreeing to remain with the Council for five years, and to forego for work done, after the end of 1911, any commission which, as consulting engineer, he would otherwise have been entitled to. Mr. Fenby, who opposed, considered it unfair to tie Mr. Beckett to Bridlington for five years, and that the recommendation would prevent him from getting promotion.

MR. F. W. HIGHFIELD, consumers' engineer in the Worcester electricity department, has been appointed showrooms assistant to the Birmingham electric supply department. There were 117 applications.

MR. H. TAYLOR, late shift engineer Luton Electricity Works, has been appointed boiler house superintendent, and MR. W. J. RABY, senior switchboard attendant, has been appointed shift engineer.

General.—MR. GEORGE BALFOUR, of Balfour, Beattie and Co., Ltd., Edinburgh and London, has made hosts of new friends in the Govan division, as the increase in the Unionist vote shows. Throughout the contest he worked at high pressure, and from morning till night he was engaged discussing political questions with workers and addressing meetings. His speeches on the Insurance Act attracted very wide attention, not only in the constituency but throughout the country. Interviewed by a representative of the ELECTRICAL REVIEW, Mr. Balfour stated that he had never known working men to be so gravely concerned regarding any great question as they were in the case of the Insurance Act. Only time was needed, he thought, for them to study it, and, once they understood its real meaning, they would not tolerate it. It is understood that Mr. Balfour, had he wished, could have had a safe seat, and the pluck he has shown in fighting Govan, where the majority against him at the General Election was so large, is greatly admired.

MR. C. LLEWELYN DAVIES has been appointed solicitor to the Post Office jointly with SIR ROBERT HUNTER, K.C.B., "who will continue to act until the arrangements connected with the transfer of the National Telephone Co.'s undertaking are completed."

LORD FURNESS has been elected deputy chairman of the Metropolitan Railway, in place of the late Sir William Birt. Mr. Paul Speak is to be appointed an additional director.

We are informed that MR. E. C. REED, chief publicity writer to the Westinghouse Co.'s Publishing Department, has been appointed sales manager to Messrs. Miles Sykes & Sons, of Calder Works, Sowerby Bridge. Mr. Reed will take up his new duties early in the the new year.

CITY NOTES.

Schuckert Electricity Co.

THE Elektrizitäts Gesellschaft vorm. Schuckert Co. is now mainly an investment undertaking, although the company still owns certain central stations. The directors' report for 1910-11 draws attention in the first place to the known loan transaction with the Siemens-Schuckert Works, which necessitated an increase of £500,000 in the company's share capital. Negotiations in regard to the supply of Northern Bavaria with electrical energy had led to the conclusion of many contracts with local authorities in connection with the recently-opened station at Ansbach. These local authorities were to be supplied in three years, provided that the applications guaranteed a suitable return. The northern long-distance cable in the Erlanger district had been brought into use in regard to 42 communes, whilst the western cable to Lower Franconia, which was to supply 85 communes, was in course of construction, and would be started in the present winter. The report also refers to the formation of the Franconia power works, in which the company and the towns of Nuremberg and Furth were interested, and which proposed the erection of works for affording a supply to those two towns by the end of 1912. The following figures are extracted from the accounts:—

	1910-11.	1909-10.
Share capital	£3,000,000	£2,500,000
Bond capital	1,955,000	1,925,000
Gross profits	362,000	326,000
Net profits and balance forward ..	293,000	260,000
Dividend, per cent.	7½	7

The dividend on the additional share capital of £500,000 is only payable for six months. Among the assets the shares of £2,247,500 held in Siemens-Schuckert works remain unchanged as contrasted with 1909-10, and central stations stand at £74,000, as against £129,000 a year ago. On the other hand, securities have risen from £1,873,000 to £1,937,000, and syndicate holdings from £125,000 to £149,000.

Siemens-Schuckert Works.

The report of the Siemens-Schuckert Werke for 1910-11 refers to the acquisition of new sites in Berlin and Nuremberg for the extension of works, which would be completed in the course of the new financial year. The new cable factory in Gartenfeld was approaching completion, and a new building for the construction of transformers was being erected in Nuremberg. Two loans of a total of £3,000,000 had been raised for the purpose of proceeding with the extensions, as well as for the increased stocks of materials, manufactures and outstanding debts. The degree of employment during the year was such that night shifts had frequently to be worked, notwithstanding the enlargement of the works, and a further augmentation in the orders had taken place in the first months of the new year. The company's works in Germany and elsewhere delivered 95,116 machines, motors and transformers in 1911 of a total of 2,646,327 H.P., this number comparing with 66,227 of 2,100,879 H.P. in the preceding year, and the advance in individual outputs again kept step with the increase in the turnover. Motors up to 16,000 H.P. were constructed for reversing rolling mill trains, and primary machines up to 21,500 KW. at 1,000 revolutions were carried out for power stations. The extensive use of metallic-filament lamps, the rearrangement of tariffs, and the great progress of driving by electric power, had led to the further development of existing central stations, to the establishment of new overland stations, and to a more abundant opportunity for work. Electrical working in the mining and iron and steel industries had made progress, and orders for winding engines were again received to a large extent. Apart from the growing interest in overland electric railways and industrial railways, the Prussian State Railway authorities had decided, as the trial section between Dessau and Bitterfeld had proved fully satisfactory, to make various extensions of this method of electrical working. The report adds that despite the abundance of work available, it was impossible to maintain the prices of manufactures on the level which prevailed in 1909-10. The accounts show the following figures for the two years :—

	1910-11.	1909-10.
Ordinary capital	£4,500,000	£4,500,000
Bond capital	2,458,000	969,500
Non-terminable 6½ per cent. loan	1,500,000	—
Gross profits	913,000	695,000
General expenses	95,000	74,000
Depreciation provision	50,600	50,400
Net profits	668,000	526,000
Placed to reserve fund	125,000	—
Bonuses	65,000	50,000
Benevolent fund	17,500	17,500
Dividend	450,000	450,000
„ per cent.	10	10

The ordinary capital and non-terminable loan are held in almost equal halves by the Siemens & Halske Co., and the Schuckert Co. During the year the number of officials and workmen, including the foreign branches, increased by 14,000 to 66,000.

African Trans-Continental Telegraph Co., Ltd.

The following circular was issued by the company :—"The annual reports and balance-sheets submitted at the recent general meetings of the company, and the chairman's remarks at those meetings, will have shown you the position of the company's affairs. This position is further apparent in the accounts as received for the year ended March 31st, 1911, which show that the company's indebtedness has increased to £105,799. The revenue has fallen from £4,662 in 1904—the first year after the completion of the line to Udjidji—to £3,076 in 1911. As there appears to be no prospect of the revenue improving sufficiently to show a surplus over expenditure, and there are no means of reducing the general indebtedness of the company, your directors, after consulting the principal shareholders and creditors, have come to the conclusion that it is desirable for the company to go into voluntary liquidation forthwith. It is proposed to appoint Mr. Percy Johnstone Baird, who has for several years been familiar with the accounts of the company in Africa, as liquidator."

An extraordinary general meeting of the company was held on Wednesday, last week, at the office, 2, London Wall Buildings, E.C., to consider the advisability of winding up.

The Duke of Abercorn, who presided, moved a resolution for voluntary liquidatioon. He said that the company was formed at the instance of the late Mr. Cecil Rhodes in 1892, with an initial capital of £140,000 for the purpose of constructing a line from Salisbury, in Southern Rhodesia, to which point a telegraph line had already been constructed by the British South Africa Co. to Wady Halfa, in Egypt, a distance of 3,000 miles. The capital of the company was increased in 1898 to £300,000. Mr. Rhodes's original idea of a Cape to Cairo line was to assist in the development of the territories through which the line would pass and to compete with the submarine cables in through traffic to Europe. When this project was first started the cost of cable messages between England and South Africa was about 9s. a word, as against 2s. 6d., which was the estimated cost by an overland route. The Cable Co.'s charges, however, had now been reduced to 2s. 6d. per word. Of the issued capital of £226,850, £86,577 was subscribed by the British South Africa Co., and £84,354 by Mr. Rhodes or his trustees. Great difficulty was experienced in the early days of the construction, one section being destroyed during the rebellion. The line had only been carried so far as Udjidji, in German East Africa, and to build and maintain the line so far as it had, the company had had to incur a debt of £105,539 to the British South Africa Co. No construction had taken place since 1903, and it was estimated that it would cost a further £50,000 to complete the missing gaps in German East Africa and Uganda, amounting to 550 miles, before the Cape to Cairo telegraph line would be completed. They would have noticed from the recent annual reports and balance-sheets, and the chairman's remarks at the general meetings, what was the position of the company, and they would have been prepared for the notice sent them with regard to the proposed liquidation of the company. It was with much regret that they had called the shareholders together for this purpose, but having regard to the position he had set out, there was, he was afraid, no other solution of the difficulty.

Mr. R. Maguire seconded the resolution, which was adopted unanimously.

German Electrical Companies.

The Deutsche Beck Bogenlampen Gesellschaft, it is stated, has now brought to a conclusion the negotiations which have been proceeding for months in regard to reconstruction. The necessary funds are being provided by the issue of preference shares, additional payments on old shares and their conversion into the preference class, and by means of long term credits. A thorough reorganisation of the whole undertaking is associated with the scheme, and has already been carried out in part.

The Fabrik Isolierter Drähte zu Elektrischen Zwecken (Insulated Electrical Wire Works), of Berlin, report a surplus of £38,000 for 1910-11, as contrasted with £17,000 in 1909-10. After meeting general expenses and allocating £5,300 to depreciation, as against £3,900 in the previous year, the accounts show net profits of £19,000, as compared with £6,000. It is proposed to pay a dividend of 11 per cent. on share capital of £67,500, as against 7 per cent. in 1909-10, and 5½ per cent. on the new capital of £107,500. The report states that the favourable course of business continues and the large amount of orders on hand will afford full employment for months.

The Rheinische Schuckert Gesellschaft, of Mannheim, which owns and works various electric supply works and tramways, has just declared the previously-reported dividend of 7½ per cent. for 1910-11, as compared with 7 per cent. in the preceding year. It would appear from the annual report that the company is developing a large scheme of expansion in overland central stations in the Upper Rhenish district, where it is sought to secure a position of monopoly. The Rhine-Hessen undertaking will supply 134 localities, and it has been arranged that the Worms works shall co-operate with the Mayence municipal works in the event of any interruption in the supply from either stations.

The report of the *Telephon Fabrik Ges. vorm. J. Berliner, of Hanover*, which has just declared a dividend of 8 per cent. for 1910-11, as compared with 12 per cent. in the preceding year, states that the principal reason for the decline in the net profits on the same turnover as in 1909-10 was to be found in the circumstance that the works were more dependent upon the export trade than formerly, and this necessitated increased expenses. Government orders were also of less extent. The branches were sufficiently employed, and the participation in the French and English trade yielded satisfactory profits. The Buda Pesth factory, which was converted into a company, was fully occupied in the second half of the year, and a considerable stock of orders was brought over into the new year. The department for wireless telegraphy had to be equipped, although it had not yet resulted in substantial profits. The net profits were £23,000, as against £32,000 in 1909-10. It was mentioned at the recent meeting that the orders received for Government account had improved in the new financial year.

Stock Exchange Notices.—Applications have been made to the Committee to appoint a special settling day in and to grant a quotation to :—

Mexican Light and Power Co., Ltd.—Fully-paid scrip for £1,000,000 5 per cent. second mortgage 50-year bonds.

And to allow the following securities to be quoted in the Official List :—

Central London Railway Co.—£385,000 4½ per cent. preference stock, in lieu of the scrip, together with £95,000 additional 4½ per cent. preference stock.

Consolidated Gas, Electric Light and Power Co. of Baltimore.—$7,100,034 common stock in shares of $100 each; and $6,860,054 6 per cent. preferred stock in shares of $100 each.

Marconi's Wireless Telegraph Co., Ltd.—According to the financial Press, the secretary of this company has just issued a circular as follows :—"I am directed to inform you that the dividend on the 7 per cent. cumulative participating preference shares for the six months ending December 31st, 1911, will be paid on February 1st next. The company having interests in so many distant countries, it is feared that some six months must elapse before it will be possible to present the accounts for the year 1911. Therefore, feeling satisfied that the year's results will warrant their action, the directors have declared a further interim dividend on the ordinary shares at the rate of 5 per cent., making a total distribution to date of 10 per cent. for the year ending 1911. Should it be determined at the annual general meeting to make a further distribution in respect of the year 1911 both classes of shares would rank equally therein. The transfer books of the company will be closed from January 1st to 7th, 1912."

Direct West India Cable Co., Ltd.—The directors have declared an interim dividend at the rate of 6 per cent. per annum (1s. 6d. per share), free of income-tax, on the ordinary shares for the half-year to December 31st.

Siemens & Halske Co.

THE report of the directors records a fresh increase in the orders received in 1910-11. In some departments a decline in prices was perceptible, but this was partly compensated by a larger output and partly by the advantageous development of other branches. The company realised £750,000 through the sale of Government securities, and transferred the sum as a loan to the Siemens-Schuckert Works. Noteworthy progress was made in the light electrical engineering departments. Automatic telephone exchanges had stood the test in every respect in Germany and abroad, and further orders had consequently been given by public authorities and private undertakings. The use of the Pupin loaded coil system both for cables and aerial lines had been further developed with good success, and the submarine telephone cable between Dover and Calais had been followed by the laying of a similar cable between England and Belgium. In the case of wireless telegraphy, the Gesellschaft-fur Drahtlose Telegraphie, of Berlin, had united with the Brussels Marconi Co. for the formation of the German Wireless Operation Co., the object of which was to erect and work stations on German merchant vessels. The equipment of the principal home railways and lines in other countries with the S. and H. section blocking system had again progressed. The development of the Wotan lamp had substantially advanced, and the company had arranged with the General Electric Co., of New York, for a mutual exchange of inventions and experience in this respect, the arrangement having been extended to the A.E.G. and the Auer Co. Concerning the recent reduction in the prices of glow lamps, the report states that it is believed that compensation will be obtained from increased sales, both of the Wotan lamp and the tantalum lamp. The accounts contain the appended figures :—

	1910-11.	1909-10.
Share capital	£3,150,000	£3,150,000
Bond capital	1,287,000	1,308,000
Gross profits	691,000	644,000
Depreciation	22,000	22,000
Net profits and balance forward	616,000	575,000
Special reserve fund	111,000	25,000
Bonuses	40,000	35,000
Dividend	378,000	378,000
,, per cent.	12	12
Carried forward	54,000	53,000

The extension of the Berlin Underground Railways again yielded large orders, and the new power station on the Lower Spree for the Elevated and Underground Railway Co. would shortly be opened, whilst the starting of a portion of the Hamburg Suburban Railways would also take place in the near future.

Tata Hydro-Electric Power Supply Co., Ltd.

THE first annual meeting of this company was held at Bombay on November 2nd. Mr. R. D. Tata, who presided, moved the adoption of the report of the directors, the outstanding features of which were that certain contracts had been placed, certain lands taken possession of, a certain amount of excavation, masonry and building work had been done, and preparations had been in progress to obtain labour and raw material for further work this season, and for placing further contracts. More important than all is the sale of the company's power to Bombay factories. Their advisers were generally satisfied with the progress made, and on the whole, their outgoings on capital expenditure did not exceed the provision made in the estimates. In the matter of the sale of power, the agreements had been liberally drawn up to give every facility to the consumers, and the price charged had been appreciated also as liberal to the consumers. That the directors believed in the expected profit they proved by putting money into the Hydro-Electric Co.; that they believed the supply rate to be favourable, they demonstrated by applying for power on behalf of their concerns. It was a matter of regret to his firm that they could not secure the contract for the supply of power to the Swadeshi Mills at Kurla, of which they were the agents, because it was not situated in the municipal limits of Bombay city. He asked them to pass a resolution authorising payment of dividends out of capital at the rate of 4 per cent. to ordinary and preference shareholders. The interest earned on their moneys during the period under review would be more than enough to provide for payment of interest to debenture-holders, and in the estimates of capital ample provision had been made for the dividends out of capital to shareholders which they would be asked to approve.

SHRIMANT GANPATRAO GAEKWAR seconded the proposition, which was unanimously carried.

The report referred to above contained the following notes respecting the progress of the works :—

"*Lanowla Dam.*—A length of 3,200 ft. of trench is in progress, and of this 1,200 ft. has been practically completed. The total quantity of excavation to date amounts to 6,530 hundreds of cubic feet. Masonry was commenced on March 8th, and is in progress over a length of 780 ft.; the quantity built to date amounts to 916 hundreds of cubic feet.

"*Walwhan Dam.*—Good progress has been made with the work of this Dam and the foundations have proved satisfactory. A length of 2,550 ft. of trench is in hand, 500 ft. of which is completed. Total quantity of excavation done is 6,810 hundreds of cubic feet. Masonry is in progress over a length of 380 ft., 200 ft. of which is built up to ground level. Total quantity built to date is 1,177 hundreds of cubic feet.

"*Duct.*—Excavation was commenced on a short length at the Walwhan, the total quantity excavated being 1,070 hundreds of cubic feet.

"*Tunnel Work.*—This work has uninterruptedly been proceeded with throughout the rains, excavation being done at each end. Quarters have also been erected for coolies at both ends. The tunnel is now driven 55 ft. and 75 ft. on the Shirawta and Javre sides respectively, the total length of tunnel being 5,000 ft.

"*Materials.*—Quarries for supplying Walwhan dams with stone have been opened up in the vicinity of both dams, and a quantity of stone has been collected. Lime sheds have been erected also at both dams, and a large stock of this material has been stored for use after the monsoon. The majority of this lime has been received from Bombay, but Messrs. Pauling & Co. have opened out kilns at Pomalwadi, and a small quantity of lime has already been received from these. A quantity of sand has been stacked at both dams.

"*Tenders.*—Tenders for power house, pipe line and transmission line have all been received from the consulting engineers, and have been submitted. It has been decided to accept tenders of Messrs. Escher, Wyss & Co., Zurich, Switzerland, for their hydraulic turbines; Messrs. Siemens, Berlin, Germany, for generators and exciters; and the General Electric Co., of New York, for the 100,000-volt transformers and switch apparatus. The other tenders are under consideration.

"*Receiving Station Site.*—A site at Parcel, which is very favourably situated and quite central for most of the mills, has been purchased. Foundation tests were made and proved favourable.

"*Cable-Distributing System.*—A contract was entered into with the Callender's Cable Co. for the supply and maintenance of an underground cable system for the purpose of conducting the electrical power from the receiving station to our consumers, with provision for complete installation and maintenance by the contracting company.

"*Sale of Power.*—Applications have been received aggregating approximately 34,000 I.H.P. for supplying power to the mills. Tests in accordance with guarantors' agreement are now being carried out, and lists of machinery and general details scheduled, so that formal contracts may be entered into. The work of testing and gathering general information in this connection is now two-thirds completed.

"A telephone line has been laid by the company connecting up the the tunnel ends and the dams with the contractors' and engineers' office. A portion of this line will afterwards form part of the permanent telephone system required when power supply is started.

"Labour supply was fairly good until the end of April, when the coolies started leaving for cultivation work, but it is expected that at the end of this monsoon labour will have arrived in large quantities to contend with the work in hand. Arrangements have been made with Messrs. Boyce & Co., army contractors, to open shops for supply of food stuffs to the workmen at fixed rates in relation to market prices.

"The general progress has been equal to expectations, and there now appears to be no reason why the work should not be carried out with all anticipated expedition."

Horsfall Destructor Co., Ltd.—Colonel A. P. James presided at the meeting of this company at Westminster Palace Hotel, S.W., on December 20th. He said that the turnover for the year was better by £7,585 than in 1910, and the general expenses were down £435. Though a net profit of £4,500 was earned, they thought it would be unwise to recommend any dividend in present circumstances. After providing for debenture interest, £3,676 remained, and of that £1,313 was to be transferred to reserve for depreciation of patents, and £500 placed to reserve for bad and doubtful debts. They had brought the cost of production down to a minimum, and their tenders would now be on keen competitive lines. If they could get a reasonable share of business they would go on progressing, and next year it might be possible to pay a substantial dividend.

Melbourne Tramway and Omnibus Co., Ltd.—The directors announce a dividend of 4½d. per share for the current quarter, and a bonus at the rate of 5 per cent. per annum for the half-year ending the 31st inst., making 7½d. per share.

Calcutta Electric Supply Corporation, Ltd.—The number of units delivered to consumers during the four weeks ended November 24th, 1911, were 739,287, compared with 626,393 units in the corresponding four weeks of 1910.

STOCKS AND SHARES.

Tuesday Evening.

ONLY a sterner sense of duty than a writer on finance might be expected to possess is responsible for any Stock Exchange article at all this week. The only things of fresh interest that are worth mentioning since our last notes under the above heading appeared are lively movements in Marconi shares, Underground Income bonds, and National Telephone Deferred stock, the last-named rising in rocket-like fashion upon a general tip to buy on the eve of the Government's pronouncement with regard to the price that is to be paid for the undertaking.

In the circumstances, it would appear an appropriate occasion for comparing the prices of a year ago with those current to-day—which, incidentally, is not the least laborious task that can be set during a Christmas season. Moreover, we have the solemn assurance of many people that nobody ever looks at lists of comparative prices. But this, of course, must be in respect of other markets, for the movements in electrical issues are always so interesting

that not to set them out would be to court reproach. The year has seen a good many vicissitudes in quotations, with an ever-increasing interest in Latin-Canadian issues of the electrical type; but we start our short catalogues with a list of Home Railway stocks, showing the fluctuations of the year :—

Stock or share.	Dec. 31, 1910.	Dec. 22, 1911.	1911. Highest.	1911. Lowest.
Central London Ordinary	64	68	78⅜	63½
" " Deferred	45	51	67⅛	44½
City and South London	28	31	36½	26⅝
Metropolitan	41½	43½	55¼	39⅜
Metropolitan District	27⅝	34¼	34⅜	23¼
Underground 6 per cent. income	39	73	75	39

Following the above, we may proceed to the prices of some of the more popular tramway and traction issues, in which it will be seen that the feature is the big rise that has occurred in Sao Paulo stock. Where nothing is mentioned, it is to be understood throughout these lists that the stock or share quoted is of the Ordinary class.

Stock or share.	Dec. 31, 1910.	Dec. 22, 1911.	1911. Highest.	1911. Lowest.
Anglo-Argentine Trams 1st Pref.	4⅞	5⅛	5 5/16	4 13/16
British Columbia Deferred	144	138½	153½	138½
British Electric Traction Ord.	1½	1½	2⅜	1⅜
" " " Pref.	3⅜	4¼	5¼	3⅜
London United Trams Pref.	1⅜	3⅛	4 1/16	1 13/16
Mexico Trams	124	122	130½	114½
Rio Trams	105½	114½	120	104
Sao Paulo	153½	186	192	154

For lighting companies the twelvemonth has been one in which the transition stage still holds investors back from putting much money into companies that are known to have been hit heavily by the introduction of the metallic-filament lamp in the first place, and by the revived energy displayed by the gas companies in the second. Within the last few weeks a firmer tendency has been manifest, and these are some of the principal changes on the year :—

Stock or share.	Dec. 13, 1910.	Dec. 22, 1911.	1911. Highest.	1911. Lowest.
Brompton	7⅛	8¼	8⅛	7
Chelsea	3⅜	4½	4 7/16	3⅜
Charing Cross	3½	3¾	4⅜	3½
City of London	11⅛	12⅜	13⅜	11
County of London	7⅜	9⅛	9⅜	7¼
Kensington	6½	7	7⅜	6⅜
Metropolitan	3⅜	3½	4⅜	3⅜
St. James'	7⅜	8	9⅛	7⅜
Westminster	7⅜	8½	8⅝	7⅜

Several of the principal Colonial and foreign descriptions deserve to be mentioned, and this is a very short table of representative examples :—

Stock or share.	Dec. 31, 1910.	Dec. 22, 1911.	1911. Highest.	1911. Lowest.
Calcutta	6⅜	6½	7⅜	6½
Canadian General	104	112½	119½	103½
Mexican Light and Power	89½	88⅝	95⅝	79½
Montreal	102½	198	199	144
Northern Light 5 per cent.	79	40	79½	39½
Shawinigan	111½	126	126½	111
Victoria Falls Pref.	1 1/16	2	1 1/16	2

In the Telegraph market the feature, of course, has been the wonderful rise in the price of Marconi shares. Changing hands as low as 12s. 6d. at one time, they have quite lately been up to £3, the latter price being *ex* valuable rights in respect of the new issue that was made to provide more working capital. The remarkable recovery shown by the rise rests upon the fact that the company's chief competitors have come into a working agreement, while the field of its operations expands year by year. At the same time, that there is plenty of scope for the older concerns has been abundantly demonstrated, and the prices of the latter have not been much affected. Here are a few examples of leading stocks and shares in this section :—

Stock or share.	Dec. 31, 1910.	Dec. 22, 1911.	1911. Highest.	1911. Lowest.
Anglo-American Preferred	115	111	118½	110½
" " Deferred	28⅜	26½	28⅞	24⅝
American Telephone & Telegraph	145	143½	157⅞	138
Eastern Telegraph	136½	139	140⅝	134½
Eastern Extension	13½	13¾	14⅛	12⅞
West India and Panama	1⅞	2⅛	2⅜	1⅝
National Telephone Deferred	129	133	146	112
Marconi	1 1/16	2⅛	2 1/16	1 1/16

Manufacturing varieties, apart from India-Rubber shares, have attracted no particular attention, and the movements shown in a brief list of prices are explained by causes easily remembered. These are some of the chief fluctuations :—

Stock or share.	Dec. 31, 1910.	Dec. 22, 1911.	1911. Highest.	1911. Lowest.
Aron	⅜	1 1/16	1 1/16	⅜
Babcock	5⅞	6	6⅞	5⅜
British Insulated	7	6⅝	7⅜	6⅛
Brit. Westinghouse 4% Debenture	58½	57½	64	55
Callender's	9⅜	9⅛	9⅜	8⅜
Dick, Kerr	1 1/16	1 1/16	1 1/16	1 1/16
General Electric Preference	8⅛	9⅛	9⅛	8 1/16
Henley's	12½	12½	13⅛	12
India-Rubber	15⅜	10	17	10
Telegraph Construction	89	85	40	34

It is, of course, impossible to even touch upon many of the most important points of the year in so short an article, which, after all, is intended to be statistical rather than anything else. The coming year will open with a brighter outlook for Home Electrical Supply companies, with a keen public demand for Latin-Canadians, and with public attention widely stirred by the giant strides of progress made by the District Railway; and prices should respond readily enough if business improves. It is with a sincere hope that everything which our readers buy may "go up" that we conclude this *résumé* of the old year, and with the expression of our best wishes for a very prosperous 1912 to all who read these notes so patiently.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

Locality.	Fortnight ended.	Receipts for the fortnight. £	Receipts for the fortnight. £*	No. of wks.	Total to date. £	Total to date. £*	Route miles open.	Inc.
Aberdeen	Dec. 20	2,793	+ 196	29	44,285	+ 2,474	..	..
Ayr	" 23	886	+ 9	32	10,808	+ 98	8	..
†Bath	Nov. 25	649	+ 16	48	40,218	+ 1,243	..	..
†Birkenhead	Dec. 19	1,089	— 1	37	42,780	+ 1,474	13·7	..
Birmingham Corp.	" 16	19,415	+4,692	37	317,958	+63,181	56·4	..
Blackburn	" 20	2,056	+ 62	38½	44,575	+ 3,708	14·6	..
Blackpool Corp.	" 21	829	+ 87	..	57,767	+ 7,440	..	..
†Blackpool-Fleetw'd	" 16	215	— 5	24	25,235	+ 2,068	..	..
†Bolton	" 2	2,412	+ 172	36	90,575	+ 6,040	26	..
Bournemouth	" 20	2,942	+ 155	38	69,658	— 200	21·9	..
Bradford	" 16	10,031	+ 428	36	205,143	+13,861	56	1·2
Brighton	" 24	1,711	+ 5	38⅞	41,132	+ 2,264	9·5	..
Bristol	" 22	12,547	+ 826	..	..	..	..	..
Brit. Elec. Trac. Co.								
Airdrie	Dec. 15	598	+ 101	50	11,425	+ 524	3·65	..
Barnsley	" 15	863	+ 21	"	9,272	+ 683	..	..
Barrow	" 15	988	+ 142	"	15,488	+ 2,3·0	5·37	..
Devonport	" 15	988	+ 100	"	24,970	+ 3,662	8·85	..
Gateshead	" 15	2,083	+ 83	"	52,308	+ 2,851	11·25	..
Gravesend	" 15	402	+ 7	"	10,679	+ 368	6·5	..
Greenock	" 15	1,424	+ 501	"	36,803	+ 6,005	7·25	..
Hartlepool	" 15	471	+ 99	"	13,630	+ 1,458	6·72	..
Kidderminster	" 15	178	— 13	"	5,791	+ 301	..	..
‡Leamington	" 15	276	+ 3	"	8,837	+ 439	..	..
Merthyr	" 15	396	+ 11	"	10,454	+ 304	2·9	..
Metropolitan	" 15	16,225	+1,476	"	438,588	+65,032	22	..
Middleton	" 15	583	+ 15	"	16,964	+ 1,318	8·5	..
Mid.Joint Com'tee	" 15	3,416	—3,454	"	260,169	—30,523	..	..
Oldham—Ashton	" 15	1,106	+ 35	"	28,792	+ 1,811	9·13	..
Peterborough	" 15	219	+ 2	"	6,405	+ 626	5·31	..
Potteries	" 15	4,194	+ 128	"	98,120	+ 8,811	29	..
Rothesay	" 15	79	— 2	"	10,114	+ 57	2·75	..
Southport	" 15	461	— 4	"	15,054	+ 568	8·17	..
S. Metropolitan	" 15	1,381	+ 3	"	42,769	+ 2,168	..	..
Swansea	" 15	2,132	— 5	"	57,225	+ 3,246	12·5	..
Tynemouth	" 15	278	— 14	"	12,839	+ 388	3·75	..
Weston-s-Mare	" 15	49	— 2	"	8,187	+ 1,052	3	..
‡Worcester	" 15	480	— 18	"	14,620	+ 370	5·75	..
Wrexham	" 15	196	+ 11	"	5,126	+ 298	..	..
Yorks. Wool. Dist.	" 15	2,003	+ 95	"	52,773	+ 3,537	17	..
Miscellaneous	" 15	405	+ 30	"	11,499	+ 748	..	..
Burnley	" 23	2,873	+ 314	..	..	..	11·75	..
†Burton-on-Trent	" 17	261	— 20	37	10,817	+ 552	6·62	..
†Bury	" 17	1,146	+ 32	37	48,211	+ 4,012	22·5	..
†Cardiff	" 16	2,350	+ 155	37	91,8·9	+ 6,861	..	..
Chatham and Dist.	" 21	1,603	— 96	..	43,389	— 115	15	..
Cork	" 21	984	— 17	..	25,3·7	+ 546	9·9	..
Croydon	" 1	2,991	+ 210	35	64,048	+ 4,651	11·4	..
†Darlington	" 9	201	+ 15	37	8,201	+ 764	..	..
†Darwen	" 15	246	+ 1	37	10,005	+ 710	4·36	..
Dover	" 16	375	+ 21	37	9,842	+ 1,368	4·75	..
†Dublin	" 15	5,259	— 82	..	147,461	+ 11,866	54	..
Dundee	" 22	2,212	+ 37	27	82,513	— 760	15	..
†East Ham	" 16	1,044	— 22	37	41,056	+ 2,276	7·87	1
Exeter	" 22	624	+ 33	38	13,324	+ 876	5·5	..
Glasgow	" 23	36,127	— 174	..	563,355	+36,131	98	..
†Hastings	" 14	694	— 4	..	..	+ 62	..	..
Huddersfield	" 16	3,612	+ 24	37	71,527	+ 7,149	29·5	1
Hull	" 23	6,362	+ 387	38	111,816	+ 6,004	14·5	..
Ilkeston	" 22	244	— 8	38	5,055	+ 87	..	..
†Ipswich	" 16	289	— 10	37	16,981	+ 889	10·5	..
†Kilmarnock	" 16	151	+ 8	21	5,146	+ 407	4·25	..
Lancashire United	" 20	2,496	+ 48	51	68,573	+ 2,563	39	..
Leeds	" 16	14,539	+ 909	37	281,637	+19,485	50·75	2
†Leicester	" 16	2,499	+ 87	..	..	..	..	..
Leith	" 23	1,180	+ 117	31⅝	20,978	+ 1,607	8·7	..
Liverpool	" 16	29,540	+ 882	50	573,397	+18,688	116	2·5
†L.C.C.	" 13	84,756	+ 998	..	1,624,001	+85,484	139	5
†London United	" 16	5,247	— 256	..	822,953	+11,380	..	..
†Lowestoft	" 16	177	+ 2	11	1,948	+ 16	3·5	..
†Manchester	" 16	16,127	+ 236	37	605,908	+82,624	183	..
†Newcastle	" 16	4,824	+ 283	..	161,123	+12,781	14·5	..
Newport	" 16	1,827	— 15	37	26,455	+ 976	14·5	..
†Oldham	" 17	1,905	+ 101	38	74,001	+ 3,368	23·75	·5
†Pontypridd	" 16	397	— 17	37	15,506	— 9	5·5	..
Portsmouth	" 16	3,325	— 170	37	85,023	+ 6,537	15·25	..
Preston	" 20	1,468	+ 57	38	30,012	+ 2,115	..	..
Rotherham	" 21	1,380	+ 93	37⅝	26,152	+ 2,121	12	..
Salford	" 18	9,511	+ 194	37⅞	188,716	+ 8,284	..	..
Sheffield	" 19	6,666	+ 358	..	245,628	+15,711	40	..
†Southampton	" 13	1,055	— 40	37	46 382	+ 5,466	22	..
Southend-on-Sea	" 20	922	+ 102	38	27,409	+ 4,115	..	..
South Shields	" 16	1,164	+ 166	37	28,526	+ 2,526	..	..
Swindon	" 6	288	+ 22	..	5,834	+ 636	..	..
Tyneside	" 20	852	+ 172	25	12,631	+ 1,998	..	..
Wallasey	" 9	1,951	+ 147	36½	40,678	+ 5,534	..	..
†Walthamstow	" 16	646	+ 11	37	28,370	+ 1,768	9	..
West Ham	" 14	5,906	+ 178	37	101,131	+ 9,121	15·25	..
Wolverhampton	" 20	1,982	— 9	38	37,671	+ 2,007	25	..
†Con. London Rly.	" 16	5,440	— 396	24	114,564	—16,562	6·22	..
City & S. Lon. Rly.	" 24	7,196	— 188	25	80,824	— 611	7·25	..
Dublin-Lucan Rly.	" 22	326	+ 1	25	3,6·2	— 41	7	..
†G.N. and City Rly.	" 16	1,788	+ 194	24	35,010	+ 1,211	2·5	..
†L'pool Overh'd Rly.	" 17	1,544	+ 161	..	36,027	+ 2,167	6·8	4·3
†Llandudno-Col. Bay	" 15	115	+ 7	24	251	+ 18	..	..
†Lond. Elec. Ry. Co.	" 16	14,785	+ 330	24	311,560	+ 10,525	21·25	..
†Mersey Railway	" 16	2,778	+ 79	24	47,026	— 994	4·5	..
Metropolitan Rly.	" 24	39,268	+ 648	25	434,240	— 3,901	24·5	..
†Met. District Rly.	" 16	13,279	+ 512	24	269,908	+ 11,966	24	..
Anglo-Argentine	" 23	105,815	+5,043	..	2,507,903	+201,998	..	..
‡Auckland	Nov.	16 594	+ 1,168	20	81,451	+ 6,196	23·3	·3
Bombay (B.E.T.)	Nov. 24	6,533	+ 464	47	137,465	+ 8,801	..	..
‡Brisbane	Nov.	21,890	+3,150	48	227,870	+27,480	..	..
Brit. Columbia Rly.	..	..	..	..	..	..	..	..
†Calcutta	Dec. 18	3,584	+ 450	..	..	..	..	..
Cape Electric T.Ld.	..	..	..	..	..	..	..	..
‡Kalgoorlie, W.A.	Nov.	3,165	..	48	87,944	..	20·5	..
‡Lisbon	..	..	..	..	..	..	..	..
Madras	Dec. 15	1,515	+ 80	..	34,036	+ 2,840	..	..
‡Montevideo	Nov.	26,614	+2 528	..	..	..	..	..
†Perth (W.A.)	Dec. 18	1,809	+ 229	..	31,112	+17,192	29	..

* Compared with the corresponding period of 1910. † One week only.
‡ Includes horse, steam and other receipts. § One month.

SHARE LIST OF ELECTRICAL COMPANIES.

ENGLISH ELECTRICITY SUPPLY AND POWER COMPANIES.

NAME.	Stock or Share.	Dividends for 1910.	Dividends for 1911.	Closing Quotations Dec. 22nd.	Rise + or Fall —	Present Yield p.c. £ s. d.
Bournemouth & Poole, Ord.	*					
Do. 4½ % Pref.	10	5½	5†	7⅜ — 8⅜	..	6 5 9
Do. Second 6 % Pref.	10	4½	4½	8¾ — 9¼	..	4 12 4
Do. 4½ % Deb. Stock	10	6	6	10¾ — 11	..	5 9 1
Brompton & Kensington, Ord.	Stock	4½	4½	101 —103	..	4 7 5
Do. 7 % Cum. Pref.	5	10	9†	7⅞ — 8⅜	..	5 19 4
Central Electric Supply, 4 % Guar. Deb.	5	7	7	7½ — 8	..	4 7 6
Charing Cross, West End & City	100	4	4	98 —101	..	3 19 3
Do. 4½ % Cum. Pref.	5	5	5†	3¾ — 4	..	6 5 0
Do. "City Undertaking" 4½ % Cum. Pref.	5	4½	4½	4¼ — 4⅝	..	4 12 4
Do. Do. 4 % Deb.	5	4½	4½	3⅞ — 4¼	..	5 5 11
Chelsea, Ord.	100	4	4	93 — 96 xd	..	4 3 4
Do. 4½ % Deb.	5	5	4†	4 — 4½	..	5 11 1
City of London, Ord.	Stock	4½	4½	99 —102	..	4 8 3
Do. 6 % Cum. Pref.	10	7	6†	12⅜ — 13½	..	5 6 8
Do. 5 % Deb.	10	6	6	12 — 13	..	4 12 4
Do. 4½ % Second Deb.	Stock	5	5	119 —123	..	4 1 4
County of Durham, 5 % First Mort. Deb.	100	4½	4½	101 —104	..	4 6 7
County of London, Ord.	Stock	5	5	89½ — 91½	..	5 9 3
Do. 6 % Pref.	10	5	4†	8¾ — 9⅜	..	5 6 8
Do. 4½ % Deb.	10	6	6	11 — 11½	..	5 4 4
Do. 4½ % Second Deb.	Stock	4½	4½	108 —110	..	4 1 10
Edmundson's, Ord.	Stock	4½	4½	100 —103	..	4 7 5
Do. 6 % Cum. Pref.	5	Nil	Nil	⅜ — ⅝	..	Nil
Do. 4½ % First Mort. Deb.	5	Nil	Nil	2 — 2½	..	Nil
Folkestone	100	4½	4½	83 — 86	..	5 4 8
Do. 5 % Cum. Pref.	5	6	6†	4½ — 5	..	6 0 0
Do. 4½ % First Deb.	5	5	5	4⅝ — 5⅛	..	4 17 7
Hove	100	4½	4½	95 — 98	..	4 11 10
	5	9	8†	6½ — 7¼	..	6 4 2

NAME.	Stock or Share.	Dividends for 1910.	Dividends for 1911.	Closing Quotations Dec. 22nd.	Rise + or Fall —	Present Yield p.c. £ s. d.
Kensington & Knightsbridge, Ord	*					
Do. 4 % Deb.	5	9	8†	6⅞ — 7¼	..	6 4 2
Kent Elec. Power, 4½ % Deb.	Stock	4	4	94 — 96	..	4 3 4
London Electric, Ord.	Stock	4½	4½	80 — 84	..	5 7 2
Do. 6 % Pref.	3	2	..	1⅛ — 2	..	3 0 2
Do. 4 % First Mort. Deb.	5	6	6	4⅜ — 4⅝	..	6 3 1
Metropolitan	Stock	4	4	87 — 90 xd	..	4 8 11
Do. 4½ % Cum. Pref.	5	5	4†	3½ — 4	..	6 5 0
Do. 4½ % First Mort. Deb.	5	4½	4½	4⅛ — 4⅜	..	4 14 9
Do. 3½ % Mort. Deb.	Stock	4½	4½	101 —106	..	4 4 11
Midland Electric Corporation 4½ % First Mort. Deb.	Stock	3½	3½	85 — 88	..	3 19 7
Newcastle-on-Tyne	100	4½	4½	96½ — 98½	..	4 11 5
Do. 5 % Pref., Non-Cum.	5	4	4†	3½ — 4	..	5 0 0
North Metropolitan Power Supply, 5 % Mortgages (Red.)	5	5	5	4 — 4½	..	5 11 1
Notting Hill, 6 % Non-Cum. Pref.	100	5	5	99 —102	..	4 18 0
Oxford	10	..	..	10 — 11	..	..
St. James' and Pall Mall, Ord.	5	7½	6†	6½ — 6⅝	..	5 9 5
Do. 7 % Pref.	5	10	10†	7⅞ — 8⅛	..	6 1 3
Do. 3½ % Deb.	5	7	7	6⅝ — 7⅛	..	4 19 1
Smithfield Markets, Ord.	100	3½	3½	86 — 88	..	3 19 7
South London, Ord.	5	Nil	..	1⅜ — 1⅝	..	Nil
Do. 5 % First Mort. Deb.	4	5	..	2⅞ — 3⅛	..	6 3 1
South Metropolitan, 7 % Pref.	100	5	5	100 —103	+2	4 17 1
Do. 4½ % First Deb. Stock	1	7	7	1 — 1⅛	..	6 4 5
Urban, Ord.	100	4½	4½	95 — 98	..	4 11 10
Do. 5 % Cum. Pref.	5	5	..	⅛ — ⅜	..	..
Do. 4½ % First Mort. Deb.	5	5	..	2 — 2¼	..	..
Westminster, Ord.	100	4½	4½	86½ — 88½	..	5 1 8
Do. 4½ % Cum. Pref.	5	10	10†	7⅞ — 8⅜	..	5 19 5
	5	4½	4½	5 — 5⅛	..	4 5 9

COLONIAL AND FOREIGN ELECTRICITY SUPPLY AND POWER.

Adelaide, 6 % Pref.	5	6	6	5⅛ — 5⅜	..	5 4 4
Calcutta, Ord.	5	8½	7†	6 — 6⅛	..	6 10 9
Do. 5 % Pref.	5	5	5	5 — 5⅛	..	4 15 3
Calgary Power, 1st Mort. Bds.	100	5	5	96½ — 98½	..	5 1 6
Canadian Gen. El. Com.	$100	7	7†	110 —115 xd	..	6 1 9
Do. 7 % Pref.	$100	7	7	118 —122	..	5 14 9
Cordoba Lt., Power and T., Ord.	1	3	3†	⅞ — 1	..	3 0 0
Do. 5 % Deb.	100	5	..	94 — 97	..	5 3 1
Elec. Lt. and P. of Cochabamba, 6 % Bonds	100	6	6	91 — 93 xd	..	6 9 0
Elec. Supply Victoria, 5 % 1st Mort. Deb.	100	5	5	84½ — 87½	..	5 14 3
Elec. Dev. Ontario, 5 % 1st Mort. Bonds	$500	5	5	91½ — 93½	+1	5 6 11
Kalgoorlie Elec. P. and L., Ord.	10/-	Nil	..	1/16 — 3/16	..	Nil
Do. 6 % Pref.	1	6	6	3/8 — 1/2	..	8 0 0
Kaministiquia Power, 5 % G. Bs.	$500	5	5	102½ —104½	..	4 15 8
Madras, Ord.	5	..	..	2⅝ — 3⅛	..	..
Melbourne, 5 % 1st Mort. Deb.	100	5	5	100 —102	..	4 18 0
Mexican El. Lt., 5 % 1st M. Bds.	..	5	5	88 — 90	..	5 11 1
Mexican Lt. & Power, Common	$100	4	4†	87½ — 89½	..	4 9 5
Do. 7 % Cum. Pref.	$100	7	7	107½ —109½	..	6 7 10
Do. 5 % 1st Mort. Gold Bds.	..	5	5	95½ — 97½	+ ½	5 2 7

Monterey Rly. Light & Power, 5 % 1st Mort. Deb.	100	5	5	91 — 93	+ ½	5 7 6
Montreal, Lt., H. and Power	$100	7	8	196 —200	..	3 10 0
Northern, Lt., Power and Coal, 5 % 1st Mort. Bonds	$500	5	..	39 — 41	—2	12 3 10
River Plate, Ord.	Stock	10	..	235 —245	+2	4 1 8
Do. 6 % Non-Cum. Pref.	Do.	6	6	104 —110	..	5 9 1
Do. 5 % Deb. Stock	Do.	5	5	102 —104	..	4 16 2
Roy. Elec. Co., Montreal, 4½ % 1st Mort. Deb.	100	4½	4½	99 —101	..	4 9 1
Shawinigan Water, Capital	$100	4	5†	125 —127	..	3 3 0
Do. 5 % Con. 1st Mort. Bonds	$500	5	5	107 —109	..	4 11 9
Do. 4½ % Per. Deb.	Stock	4½	4½	102½ —104½	..	4 6 2
Toronto Power, 4½ % Deb.	Do.	4½	4½	98 —100 xd	..	4 10 0
Vera Cruz Lt., P. and T., 5 % 1st Mort. Deb.	100	5	5	92½ — 94½	+ ½	5 5 10
Victoria Falls Power, Pref.	1	Nil	11 7/16d.	1/16 — 1/8	..	..
West Kootenay Power and Lt., 1st Mort. 6 % Gold	100	6	6	106½ —108½	..	5 10 7

TELEGRAPH AND TELEPHONE COMPANIES.

Amazon Telegraph	10	Nil	4†	7 — 7½	..	..
Do. 5 % Deb. Red.	Stock	5	5	99 —101	..	4 19 0
American Telep. & Teleg., Cap.	$100	8	8†	142½ —144½	+ ½	5 10 4
Do. Collat. Trust	$1000	4	4	95 — 97	..	4 2 6
Anglo-American Telegraph	Stock	3½	3†	66½ — 68½	..	5 9 6
Do. 6 % Pref.	Do.	6	6	110½ —111½	..	5 7 7
Do. Def.	Do.	30/-	..	25⅝ — 26⅜	..	5 14 3
Anglo-Portuguese Tel., 5 % Mort. Deb.	100	5	5	101 —103	..	4 17 1
Chili Telephone	5	7	..	7 — 7½	..	4 16 7
Commercial Cable, Stlg. 4% Deb.	Stock	4	4	86 — 88	..	4 10 11
Cuba Telegraph	10	6	6†	9⅞ — 10⅜	— ⅛	5 14 3
Do. 10 % Pref.	10	10	10	17 — 18	..	5 11 1
Direct Spanish Telegraph, Ord.	5	4	4†	3⅛ — 3⅜	..	5 6 8
Do. 10 % Cum. Pref.	5	10	10	8⅛ — 8½	..	5 14 3
Do. 4½ % Debs.	50	4½	4½	100½ —102½	..	4 7 10
Direct United States Cable	10	4½	..	7⅞ — 8	— ⅛	5 12 6
Direct W. India Cable, 4½ % Reg. Deb.	100	4½	4½	100 —102	..	4 8 3
Eastern Telegraph, Ord. Stock	Stock	7	5†	137½ —140½	..	4 19 8
Do. 3½ % Pref. Stock	Do.	3½	3½	83½ — 85½	..	4 1 10
Do. 4 % Mort. Deb.	Do.	4	4	100½ —102½	..	3 18 1
Eastern Extension	10	7	5†	13½ — 13⅝	..	5 1 10
Do. 4 % Deb.	Stock	4	4	100½ —102½	..	3 18 1
East and S. Africa Tel. 4 % Mt. Db. Mauritius Sub.	25	4	4	99 —101	..	3 19 3
Globe Telegraph and Trust	10	5⅞	6†	10⅜ — 11½xd	..	5 6 8
Do. 6 % Pref.	10	6	6	12⅜ — 18½xd	..	4 10 9
Great Northern Telegraph	10	18	5†	32½ — 33½	..	5 8 3
Indo-European Telegraph	25	13	5†	56 — 58	..	5 12 1
Mackay Companies Common	$100	5	5†	83 — 86	+1	5 16 3
Do. 4 % Cum. Pref.	$100	4	4	72 — 75	—1	5 6 8
Marconi's Wireless Telegraph	1	5	..	2 1/16 — 2 3/16	— 1/16	..
Do. 7 % Cum. Partic. Pref.	1	16	..	2 6/8 — 2 7/8	..	..

Monte Video Telephone, Ord.	1	6	6	1 3/16 — 1 5/16	..	5 12 11
Do. 5 % Pref.	1	5	5	1/16 — 1/8	..	5 6 8
National Telephone, Pref.	Stock	6	6†	104 —106	+ ½	5 13 2
Do. Def.	Do.	6	6†	131 —133	+2½	4 10 3
Do. 6 % Cum. 1st Pref.	10	6	6	9⅜ — 10⅛	..	5 14 3
Do. 6 % Cum. 2nd Pref.	10	6	6	9⅜ — 10⅛	..	5 14 3
Do. 5 % Non-cum. 3rd Pref.	5	5	5	5⅜ — 6	+ ⅛	4 3 4
Do. 3½ % Deb.	Stock	3½	3½	95½ —101½	+ ½	3 9 4
Do. 4 % Deb.	Do	4	4	99½ —101½	+ ½	3 18 10
New York Telep., 4½ % Gen. Bnds.	100	4½	4½	100½ —101½	..	4 8 5
Oriental Telep. and Elec.	1	8	..	1⅛ — 1⅜	..	4 18 6
Do. 6 % Cum. Pref.	1	6	6	1⅛ — 1 3/16	..	4 13 8
Do. 4 % Red. Deb.	Stock	4	4	88½ — 90½	..	4 8 5
Pacific and European Tel., 4 % Guar. Debs.	Do.	4	4	100 —102	..	3 18 5
Reuter's	8	5	5†	8½ — 9½	..	4 6 6
Submarine Cables Trust	Cert.	6	6	130 —133	..	4 10 3
Telephone Co. of Egypt, 4½ % Deb. Red.	Stock	4½	4½	100 —102	..	4 8 3
United River Plate Telephone	5	8	8	7⅜ — 7⅞	..	5 6 9
Do. 5 % Cum. Pref.	5	5	5	5⅛ — 5⅜	..	4 10 11
West Coast of America	2½	2½	2½	1 3/16 — 1 5/16	..	4 15 3
Do. 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	4	4	99 —101	..	3 19 3
West India and Panama Teleg.	10	1½	1½†	2⅜ — 3	..	4 3 4
Do. 6 % Cum. 1st Pref.	10	6	6	10 — 10½	..	5 14 3
Do. 6 % Cum. 2nd Pref.	10	6	6	9⅜ — 10⅛	..	5 17 1
Do. 5 % Debs.	100	5	5	103 —105	..	4 15 3
Western Telegraph, Ltd.	10	7	6†	13⅜ — 13⅞ xd	..	5 0 11
Do. 4 % Deb.	Stock	4	4	101 —103	..	3 17 8
Western Union Tel., 4% Bnds. A	$1000	4	4	106 —109	..	3 13 5
Do. 4½ % Fdg. Bonds	$1000	4½	4½	100 —103	..	4 7 5

* Unless otherwise stated, all shares are fully paid. † Interim dividend.

Continued on next page.

SHARE LIST OF ELECTRICAL COMPANIES.—(*Continued.*)

ELECTRIC RAILWAYS AND TRAMWAYS.—HOME.

NAME.	Stock or Share.	Dividends for 1910.	Dividends for 1911.	Closing Quotations Dec. 22nd.	Rise + or Fall —	Present Yield p.c. £ s. d.
Bath Trams, Pref. Ord.	1	Nil	Nil	⅛ — ¼	..	Nil
Do. 5 % Pref.	1	5	5	⅝ — ¾	..	6 13 4
Do. 4½ % Deb.	100	4½	4½	80 — 85	..	5 5 11
Brit. Elec. Trac., Ord.	10	Nil	Nil	1 — 1¼	+ 1/16	Nil
Do. 6 % Pref.	10	1½	1½	4 — 4½	+ ⅛	3 6 8
Do. 5 % Deb.	100	5	5	92 — 95	..	5 5 3
Do. 4½ % 2nd Deb.	100	4½	4½	79 — 83	+1	5 8 5
Central London Railway, Ord.	100	3	3†	67 — 69	..	4 5 9
Do. Pref.	100	4	4	84 — 86	..	4 13 0
Do. Def.	100	2	..	50 — 52	..	3 18 5
Do. 4 % Deb.	100	4	4	102 —104	..	3 16 11
City & South London, Ord.	100	1½	1¾†	30½— 31½	..	4 15 3
Do. 5 % Pref., 1891	100	5	5	108 —110	..	4 11 0
Do. Do. 1896	100	5	5	104 —106	..	4 14 4
Do. Do. 1901	100	5	5	103 —105	..	4 15 3
Do. Do. 1908	100	5	5	102 —104	..	4 16 2
Do. 4 % Deb.	100	4	4	100 —102	..	3 18 5
Dublin United Trams, 6 % Pref.	10	6	6	11 — 12	..	5 0 0
Great Northern & City, Pr'f. Ord	10	Nil	..	1 — 1⅛	..	Nil
Hastings Trams, 6 % Pref.	5	Nil	3†	⅝ — ¾	..	Nil
Do. 4½ % Deb.	100	4½	4½	73 — 78	..	5 14 8
Isle of Thanet Trams, 5 % Pref.	5	2½	2½	2⅜— 2⅝xd	..	4 6 11
Do. 4 % Deb.	100	4	4	77 — 82	..	4 17 7
Lancashire United, 5 % Deb.	100	5	5	79 — 82	..	6 1 11
London Elec. Railw'ys, 4 % Deb.	100	4	4	98 —100	+1	4 0 0
London United Trams, 5 % Pref.	10	Nil	..	2⅜— 3⅜	..	Nil
Do. 4 % Deb.	100	4	4	70 — 74	..	5 8 1
Metropolitan Railway Consol.	100	1⅞	2†	43½— 43⅝	..	3 3 3
Do. Surplus Lands	100	2⅜	3†	66 — 68	..	4 0 11
Do. 5½ % Deb.	100	5½	5½	90 — 92	+1	3 16 1
Do. 5½ % Pref.	100	5½	5½	86 — 88	+1	3 19 7
Do. 5½ % Con. Pref.	100	5½	5½	84 — 86	..	4 1 5
Metropolitan District Ord.	100	Nil	..	34 — 34½	+2½	Nil
Do. 6 % Deb.	100	6	6	145 —147	..	4 1 8
Do. 4 % Deb.	100	4	4	97 — 99	..	4 0 10
Do. 4 % Prior Lien	100	4	4	100 —102	..	3 18 5
Do. 4½ % First Pref.	100	5⅛	4½†	89 — 91	+1	3 11 5
Do. 5½ % Gtd.	100	5½	5½	75 — 77	..	4 10 11
Metropolitan Elec. Trams, Ord.	1	5⅛	5†	3⅞— 3¾	..	5 12 4
Do. Def.	1	Nil	..	1/32— 1/16	..	Nil
Do. 5 % Pref.	1	5	5	3/32— 1/32	..	5 3 1
Do. 4½ % Deb.	100	4½	4½	102 —104	..	4 6 7
Do. 5 % Deb.	100	5	5	101 —103	..	4 17 1
Potteries, Ord.	1	2	..	7/32— 1/8	..	..
Do. 5 % Pref.	1	5	5	13/32— 7/32	..	6 19 8
Do. 4½ % Deb.	100	4½	4½	91 — 94	..	4 15 9
South Metro. Trams, 6 % Pref.	1	6	..	⅝ — ¾	..	6 17 2
Do. 4 % Deb.	100	4	4	72 — 77	..	5 3 11
Underground Elec. Railways	10	..	..	2⅜— 2⅝	+ ⅛	..
Do. 4½ % Bonds	100	4½	4½	100 —102	..	4 8 3
Do. 6 % Income	100	1	1½†	72 — 74	+6	1 7 1
Do. Power House Debs.	100	4	4	100 —102	..	3 18 5
Yorkshire (West Riding), Ord.	5	Nil	..	⅛ — ¼	..	Nil
Do. 6 % Pref.	5	Nil	..	2⅛— 2⅜	..	Nil
Do. 4½ % Deb.	100	4½	4½	80 — 86	..	5 5 11

ELECTRICAL RAILWAYS AND TRAMWAYS.—COLONIAL AND FOREIGN.

Anglo-Arg. Trams, 1st Pref.	5	5	5½†	5 1/16— 5 5/16	..	4 14 1
Do. 2nd Pref.	5	5	5½†	4 15/16— 5 1/16	..	4 18 9
Do. 4 % Deb.	100	4	4	95 — 97	..	4 2 6
Do. 4½ % Deb.	100	4½	4½	101½—103½	..	4 7 0
Do. 5 % Deb.	100	5	5	99 —101	..	4 19 0
Auckland Trams, 5 % Deb.	100	5	5	104 —107	..	4 13 6
Bombay Elec. S. & Trams, Pref.	10	6	6	10⅞— 11⅛	..	5 5 6
Do. 4½ % Deb.	100	4½	4½	98 —100	..	4 10 0
Do. 5 % 2nd Deb.	100	5	5	98½—100½	..	4 19 6
Brisbane Trams Invt., Ord.	8	8	8†	8¾— 8⅞	..	4 12 9
Do. 5 % Pref.	5	5	5	4⅛— 5⅛	..	4 15 3
Do. 4½ % Deb.	100	4½	4½	103 —106	..	4 5 9
B. Columbia Elec. Rly., Def.	100	8	8†	136 —141 xd	—1	5 13 6
Do. Pref. Ord.	100	6	6	117 —121	—1	4 19 6
Do. 5 % Pref.	100	5	5	109 —112	..	4 9 3
Do. 4½ % 1st Mort. Deb.	40	4½	4½	100 —103	..	4 7 5
Do. 4½ % Vancouver Deb.	100	4½	4½	104 —106	..	4 4 11
Do. 4½ % Con. Deb.	100	4½	4½	101½—103½	..	4 7 0
Calcutta Trams, Ord.	8	6	..	5½— 5⅝	+ ⅛	5 4 4
Do. 5 % Pref.	5	5	5	5 — 5⅛	..	4 15 3
Do. 4½ % Deb.	100	4½	4½	102 —105	..	4 5 9
Cape Electric Trams	1	Nil	2½†	1/16— ⅛	..	4 0 0
City Buenos Aires Trams (1904)	5	5	5	5⅛— 5⅜	..	4 5 1
Do. 4 % Deb.	100	5	5	97 —100	..	5 0 0
Colombo Elec. Tr. & Lt., 5 % Deb.	100	5	5	98 — 98	..	5 2 0
Havana Elec. Rly., 5 % Bonds	$1000	5	5	102 —105	..	4 15 3
Kalgoorlie Elec. Trams	1	Nil	..	1/32— 1/16	..	Nil
Do. 5 % A Deb.	100	5	5	91 — 94 xd	..	5 6 5
Do. 6 % B Deb.	100	5	6†	58 — 62 xd	..	8 1 4
La Plata Elec. Trms, Prf.	1	6	6	⅞— 1	..	6 0 0
Lisbon Elec. Trams, Ord.	1	5⅓	6†	1 — 1⅛	..	4 8 0
Do. 6 % Pref.	1	5	6	1 — 1¼	..	4 16 0
Do. 5 % Deb.	100	5	5	96 —100	..	5 0 0
Madras Elec. Tr. (1904), Deb.	100	5	5	96 — 99	..	5 1 0
Manaos Trams & Lt., 1st Deb.	100	5	5	93½— 95½	..	5 4 9
Manila Elec. R. and Lig., Bonds	$1000	5	5	100 —102	..	4 18 0
Mexico Trams Com.	$100	7	7†	121 —123	..	5 13 10
Do. Gen. Con. 5 % Bonds	..	5	5	98 —100	..	5 0 0
Do. 6 % Bonds	100	6	6	103 —105	..	5 14 2
Para Elec. Rlys. & Lt., Ord.	5	10	10†	6⅞— 7⅛	..	6 18 0
Do. 6 % Pref.	5	6	6	5⅞— 6⅛	..	5 4 4
Do. 5 % 1st Deb.	100	5	5	97½— 99½	..	5 0 6
Perth (W.A.) Elec. Tr., Ord.	1	2½	..	1/16— 1	..	2 10 0
Do. 5 % 1st. Deb.	100	5	5	101½—103½	..	4 16 7
Rangoon El. Tr. & Sup., Pref.	5	6	6	5⅝— 5⅞	+ ⅛	5 6 8
Do. 4½ % 1st Deb.	100	4½	4½	98 —101	..	4 9 1
Rio de Janeiro Trams	$100	4½	5†	114½—115½	..	4 5 9
Do. 1st Mort. 5 % Bonds	..	5	5	103 —104	..	4 16 2
Do. 5 % Mort. Bonds	100	5	5	96½— 97½	..	5 2 10
Sao Paulo Tram, Lt. and P.	$100	10	10†	184 —188 xd	..	5 6 5
Do. 5 % 1st Deb.	$500	5	5	101 —103	—1	4 17 1
Singapore Trams, 5 % Deb.	100	5	5	82 — 85	..	5 17 8
Southern El. Tr. B.A., 5 % Deb.	100	5	5	96½— 97½	..	5 2 7
Un. Elec. Trams Monte Video	5	6	7	5⅞— 5⅞ xd	..	5 2 2
Do. 6 % Pref.	5	6	6	5 — 5⅛ xd	..	5 14 3
Do. 5 % 1st Deb.	100	5	5	99 —102	..	4 18 0
Winnipeg Elec. Rly., 4½ % Deb.	100	4½	4½	104 —106	..	4 4 11

MANUFACTURING COMPANIES.

Aron, Ord.	1	Nil	6	⅜— ½	..	..
Do. 6 % Pref.	1	9	6	6⅞— 6⅞ xd	..	7 2 2
Babcock & Wilcox	1	26	24†	5⅝— 6⅛	..	4 5 0
Do. Pref.	1	6	6	1⅜— 1½	..	4 0 0
B.I. & Helsby Cables	5	10	8†	6⅝— 7⅛	..	7 0 4
Do. Pref.	5	6	6	5⅞— 6⅛	..	4 16 0
Do. Deb.	100	4½	4½	102 —104	..	4 6 7
British Thomson-Houston, Deb.	100	4½	4½	94 — 97	..	4 13 9
British Westinghouse, Pref.	3	Nil	..	⅛— ⅜	..	Nil
Do. Deb.	100	4	4	56 — 59	—1	6 15 7
Do. 6 % Prior Lien	100	6	6	100 —102	..	5 17 8
Browett, Lindley, Ord.	1	Nil	..	1/6—2/-	..	Nil
Do. Pref.	1	Nil	..	5/- —6/-	..	Nil
Brush, Ord.	2	Nil	..	0 — ⅛	..	Nil
Do. 7 % Pref.	2	Nil	..	0 — ¼	..	Nil
Do. 4½ % Deb.	100	4½	4½	56 — 61	..	7 7 7
Do. 4½ % Second Deb.	100	4½	4½	39 — 44	..	10 4 6
Callender's Cable	5	15	10†	9 — 9⅝	..	7 13 10
Do. Pref.	5	5	5	5 — 5⅛	..	4 15 3
Do. Deb.	100	4½	4½	101 —103	..	4 7 5
Castner-Kellner	1	17½	20	8½— 8⅝	..	5 10 4
Do. Deb.	100	4½	4½	104 —106	..	4 3 4
Crompton & Co.	8	Nil	Nil	⅜— ⅝	..	Nil
Do. Deb.	100	5	5	60 — 70	..	7 2 10
Dick, Kerr	1	5	..	⅜— ⅝	..	5 14 3
Do. Pref.	1	6	6	1⅛— 1⅛	..	5 12 11
Do. Deb.	100	4½	4½	95 — 98	..	4 11 10
Edison & Swan, A, £3 paid	5	Nil	..	⅛— 1	..	Nil
Do. fully paid	5	Nil	..	⅝— 2⅜	..	Nil
Do. 4 % Deb.	100	4	4	71 — 75	..	5 6 8
Do. 5 % Second Deb.	100	5	5	77 — 80	..	6 5 0
Electric Construction	2	Nil	2½†	1/32— 1/16	..	..
Do. Pref.	2	7	7	1⅜— 1½	..	7 9 4
Greenwood & Batley, Pref.	10	7	7	7½— 8½	..	8 5 8
Do. Deb.	100	5	5	94 — 96	..	5 4 2
General Electric, Pref.	10	5	5	8⅝— 9⅜	..	5 6 8
Do. Deb.	100	4	4	85 — 90	..	4 8 11
Henley's, Ord.	5	15	10†	11⅝— 12⅝	..	5 18 10
Do. Pref.	5	4½	4½	4⅛— 5⅛	..	4 5 11
Do. Deb.	100	4½	4½	104 —106	..	4 4 11
India-Rubber, G. & T.	10	10	..	9 — 11	..	..
Do. Pref.	10	5	5	9 — 10	..	5 0 0
Telegraph Construction	12	20	10†	34 — 36	—1	6 13 4
Do. Deb.	100	4	4	100½—102½	..	3 18 5
Willans & Robinson	1	Nil	..	⅛— ¼	..	Nil
Do. Pref.	5	Nil	..	⅛— ¼	..	Nil
Do. Deb.	100	4	4	63 — 68	..	7 2 10

* Unless otherwise stated, all shares are fully paid. † Interim dividend.

The yields are calculated upon the dividends paid for 1910.

Bank rate of Discount 4 per cent., September 21st, 1911.

EXPORTS AND IMPORTS OF ELECTRICAL GOODS DURING NOVEMBER, 1911.

A MONTH ago we had occasion to remark on the excellent returns for electrical export business during October. The November returns are even better, the total of £527,187, comparing with £464,191 a month ago, and easily taking first place during 1911. Of the above total for November, telegraphic exports account for £100,712, principally in two large items for Cuba and Brazil.

During the month electrical machinery exports amounted to considerably over £200,000 in value, while cable exports approached £99,000 in value. The electric glow-lamp section, to which we may again draw attention, shows exports amounting to £15,314, or nearly £2,000 in advance of the October figures.

The imports reached £229,471 in value, a comparatively high figure, and included no particular variation from the preceding month's returns, except as regards "glow lamps," which reached a total value of nearly £45,000, as against £29,000 in October, and "arc lamps and lamp parts," which were imported to the value of £15,000, as compared with £8,000 in October.

The re-exports have recently been on the up-grade, and reached a total of £25,049, as compared with £21,720 in October.

The division of business amongst the various purchasing countries remained much as in previous months, Russia and Cuba, however, coming well up in the list owing to exceptional purchases.

Registered Exports of British and Irish Electrical Goods from the United Kingdom.

Destination of exports and country consigning imports.	Electrical goods and appliances.	Wires and cables, rubber and other insulations.	Electric lighting fittings and accessories.	Electric glow lamps.	Electric arc lamps and lamp parts.	Electric meters and instruments.	Electric machinery.	Electrically-driven machinery.	Batteries and accumulators.	Carbons.	Telephonic cable and apparatus and electric bells.	Telegraphic cable and apparatus.	Total.
	£	£	£	£	£	£	£	£	£	£	£	£	£
Russia, Sweden, Norway and Denmark ...	432	1,060	494	400	...	716	28,172	4,196	56	...	1,769	264	37,559
Germany	2,604	473	27	14	711	7	2,834	...	8	...	...	73	6,751
Netherlands, Java and Dutch Indies ...	570	3,841	227	62	176	23	419	37	...	...	34	95	5,484
Belgium	852	1,907	23	10	264	104	900	245	...	...	1,661	...	5,966
France	1,914	44	1,020	50	155	106	5,456	117	...	100	319	463	9,744
Portugal	88	37	76	...	32	19	275	732	16	...	...	...	1,275
Spain, Canary Isles and Spanish N. Africa...	364	73	315	...	...	447	1,535	...	24	...	...	95	2,853
Switzerland, Italy and Austria-Hungary ...	496	...	30	...	106	...	6,572	313	8	...	450	3	7,978
Greece, Bulgaria, Roumania and Turkey ...	113	139	32	98	80	...	270	285	139	...	4	158	1,318
Channel Isles, Gibraltar, Malta and Cyprus...	343	16	16	62	...	8	93	5	7	...	...	6,244	6,794
U.S.A., Philippines and Cuba	139	66	31	501	...	41	411	15	11	54	...	32,865	34,134
Canada and Newfoundland	957	3,473	779	1,811	88	2,042	9,114	...	223	32	832	418	19,769
British West Indies and British Guiana ...	47	...	205	...	...	28	655	...	39	12	21	26	1,033
Mexico and Central America	11	35	2	...	...	...	615	...	8	...	7	38	716
Peru and Uruguay	172	818	108	122	38	30	535	385	...	20	23	15	2,266
Chile	356	889	244	129	29	262	9,357	332	886	...	216	256	12,956
Brazil	857	1,603	598	555	...	337	7,592	180	94	...	1,391	53,284	66,491
Argentina	3,306	9,984	694	1,201	759	1,049	11,288	413	2,261	67	2,180	1,592	34,794
Colombia, Venezuela, Ecuador and Bolivia	61	52	82	...	...	...	438	...	...	...	4	50	687
Egypt and Persia	347	....	77	54	38	288	3,124	99	239	...	137	557	4,960
British West Africa	84	38	256	...	...	...	48	16	46	115	51	42	696
Rhodesia, O.R.C. and Transvaal	2,240	1,968	417	1,149	20	114	5,214	2	142	28	...	1,359	12,653
Cape of Good Hope	1,471	1,669	285	582	24	182	2,813	170	87	11	241	...	7,535
Natal	1,105	5,815	396	178	16	300	2,600	3,082	97	...	323	136	14,048
Zanzibar, Brit. E. Africa, Mauritius & Aden	61	...	15	22	...	17	174	...	25	...	176	671	1,161
Azores, Madeira and Portuguese Africa ...	524	588	270	30	...	...	1,427	...	35	...	4	86	2,964
French African Colonies and Madagascar ...	...	350	66	...	26	...	...	...	...	...	...	...	442
China and Siam	710	3,729	307	297	473	894	1,719	86	178	54	36	...	8,483
Japan and Korea	868	7,803	157	60	158	1,457	28,938	3,067	65	...	1,263	37	43,873
India	4,414	9,923	2,973	3,787	281	1,200	16,625	3,779	7,317	233	184	279	50,995
Ceylon	220	296	132	32	...	4	262	66	51	...	498	20	1,581
Straits Settlements, Fed. Malay States and Sarawak	614	5,886	226	44	15	15	1,508	16	24	...	158	714	9,220
Hong Kong	251	408	...	283	...	22	765	84	10	...	59	297	2,179
West Australia	175	2,934	215	20	...	519	1,889	2	88	...	4,583	36	10,461
South Australia	1,125	3,769	88	342	...	149	4,153	...	57	...	121	...	9,804
Victoria	1,432	8,392	931	820	...	934	5,727	3,332	2,651	16	1,485	24	25,744
New South Wales	3,312	15,958	344	1,019	29	822	10,221	1,125	240	...	681	164	33,915
Queensland	279	319	60	239	25	...	4,518	...	133	...	1,892	...	7,465
Tasmania	72	180	16	140	...	...	...	91	...	...	120	44	663
New Zealand and Fiji Islands	1,590	4,045	934	1,201	14	1,979	6,183	300	168	...	3,056	307	19,777
Total, £	34,576	98,580	13,168	15,314	3,557	14,115	184,439	22,572	15,433	742	23,979	100,712	527,187

Registered Imports into the United Kingdom of Electrical Goods from all Countries.

Russia, Norway, Sweden and Denmark ...	60	...	...	198	12	10	6,227	25	333	6	5,960	12,831
Germany	2,052	6,118	2,513	42,353	7,071	2,181	49,145	497	2,893	7,688	32,025	154,536
Holland	59	...	...	657	736	...	18	...	...	...	...	1,470
Belgium	674	921	42	12	24	266	3,663	8	527	502	7,798	14,437
France	173	250	1,224	736	414	174	591	286	640	2,860	396	7,744
Switzerland	140	1,501	...	26	...	234	1,790	...	4	21	32	3,748
Austria-Hungary	5	555	...	794	308	...	501	...	92	202	682	3,139
United States	2,149	473	581	...	6,397	...	8,098	7,188	311	81	5,723	31,001
Total, £	5,312	9,818	4,360	44,776	14,962	2,865	70,033	8,004	4,800	11,360	52,616	228,906

Additional imports: New South Wales, machinery, £20; Canada, goods, £105; Spain, carbons, £440.

Registered Re-Exports of Foreign and Colonial Electrical Goods from the United Kingdom.

Various countries, mainly as above ...	11,455	1,334	...	2,732	345	...	8,423	...	290	164	306	

TOTAL EXPORTS: £527,187. TOTAL RE-EXPORTS: £25,049 TOTAL IMPORTS: £229,471.

NOTE.—The amounts appearing under the several headings are classified according to the Customs returns. The first and third columns contain many amounts relating to "goods" otherwise unclassified, the latter, doubtless, consisting of similar materials to those appearing in adjacent columns Imports are credited to the country whence consigned, which is not necessarily the country of origin.

REVIEWS.

Motors, Secondary Batteries, Measuring Instruments and Switchgear. By S. Kenneth Broadfoot, A.M.I.E.E. London: Constable & Co. Price 1s. net.

This book has four chapters, one to each division of its title, and each chapter has a number of clearly-defined paragraphs. The salient fault is incompleteness, but this could hardly be avoided in so small a treatise. In Chapter I a statement of the various electrical units is hurled at the reader without any adequate introduction or explanation. The treatment given to measuring instruments, their applications and peculiarities is good, but would be greatly improved by the inclusion of wiring diagrams and illustrations showing the fundamental principles of the various instruments. The definition of a wattmeter as "an instrument that is influenced by the simultaneous values of current and voltage" is open to criticism. The introductory notes on power measurements are too cursory, familiarity with vectors is rashly assumed, and no mention is made of "leading" currents.

Chapter II includes a heterogeneous mass of information concerning the theory of electric motors and generators, and practical notes on a number of their faults. The practical notes should be useful, but the reader is introduced to shunt motors in 10 lines, alternators in eight lines and synchronous motors in 6½ lines; alternator faults are dealt with in four lines. The important practical distinctions between "cumulative" and "differential" compound motors are ignored.

Chapter III, dealing with motor-starters, circuit-breakers, starting difficulties, &c., is, on the whole, very good; a few more illustrations might well be added.

The notes on the charging and general management of accumulators (Chapter IV) are among the best in the book, and the index greatly enhances the value of the volume.

Far too much technical knowledge is assumed, considering the class of reader likely to be secured. We do not notice any actual technical errors, but the omission of explanatory matter is serious and the phraseology is often technically and grammatically lax. The book is capable of development into a really valuable handbook, but at present amounts to little more than an unsymmetrical expansion of a "pocket-book" treatment of the subjects concerned.—R. E. N.

An Elementary Course on Practical Applied Electricity and Magnetism. By Daniel H. Ogley, B.Eng. London: Longmans, Green & Co. Price 2s. 6d. net.

This little book is a compilation of experiments suitable for young students of electricity. It consists of a brief account of some 64 more or less simple experiments, and contains diagrams of the apparatus and working instructions. Dr. Rhodes, who writes the preface, says that he has been impressed for some time with the need for such a book; that students under present arrangements have about 1½ hours' practical work in the laboratory per week, and that during that time it is impossible for the instructors to get round them all; that students in many cases, therefore, think they are not getting value for their money; that however, with the present book in their hands, this disability will be removed, for such students will be informed beforehand of the experiment to be performed on any particular evening, and will thus be enabled to look up the theoretical work bearing upon it before they come to class.

We are not altogether impressed with this argument; and, as a matter of fact, we are not altogether impressed with the need for the book. The chief objection, if such a book were universally used in our technical schools, is that all elementary laboratory work (and laboratory work in the elementary stages is, without exception, the most important a young student can perform) would be stereotyped with the methods of one particular teacher. Even if the teacher is a good teacher, even if he is above the average, such a system is bad. It takes a very good teacher indeed, and one with long and varied experience, to know instinctively those parts of a subject that cause the average student trouble. Therefore we can expect to find in such compilations of laboratory experiments many instances where the instructions are not clear or lead to erroneous work. This, indeed, has occurred in those cases that have up to now been put to practical test.

Again, the actual teacher of the theoretical work should, in our opinion, have absolute charge of the laboratory arrangements. If he is an enthusiast in his work, he will not desire to have extraneous assistance in the form of lists of laboratory experiments with their accompanying instructions. Probably he would find that they did not agree in their setting out with some of his own methods; points on which he would lay special stress would be lightly touched upon or omitted altogether; methods which he had insisted upon would be violated, not necessarily in important points, but just in those little and apparently insignificant ones, which each particular teacher finds most effective for his own satisfactory teaching.

We are in nowise attacking the present work. It is excellent of its kind. Though we believe that the objects for which it is written can be obtained in a better way, in a way which allows individuality to the teacher, and arranges for the particular apparatus of each school, yet we are sure that the book itself has been carefully thought out, that the experiments are well graded, and that the instructions are clear. With one exception little improvement could be made in it. It is well known that elementary laboratory students have a rooted objection to satisfactorily writing up experiments. They don't mind doing them, but when it comes to entering them up in their laboratory note-books, it is another matter. Unless some systematic method is employed from the beginning, results at the end of the session are apt to be disappointing. Therefore, we think it would have been desirable to have included in the book a descriptive method of writing up experiments.

With regard to laboratory work, we may say here that there is a tendency to try to make of it an exact science. Enthusiasts who got hold of experimental work in its earlier stages, when all was disorganisation and confusion, saw their chance. They foresaw possibilities that were really not in it. Consequently and naturally they overshot the mark.

We are engaged to-day in trying to restore equilibrium. For this purpose we discourage all cast-iron systems, and attempts to make the teaching of scientific work automatic. Needless to say such systems are frameworks which fall to pieces of their own weight, or which get their complex joints rusted up through impossibility of lubrication.

Imperial Telegraphic Communication. By Charles Bright, F.R.S.E., &c. London: King & Son. Price 3s. 6d.

Mr. Bright is a well-known writer on telegraphic matters, and the latest addition to his list is a handy little volume in which he puts the case for Imperial telegraphs in a very condensed and convenient form. It is difficult to foresee who will read it, however. There are some, but they cannot be many, who are interested in such a subject. Those who are interested would naturally read the book on their own initiative without any suggestion from a reviewer; and it is equally certain that, no matter how the reviewer may laud it, those who are not interested would leave it severely alone. As explained in the preface, the author has made large use of reproductions of addresses and articles contributed to the British Association, the London Chamber of Commerce and various periodicals, extracts from speeches on the subject and Blue Books. With the help of these, and the promulgation of his own views, he certainly makes his case to read justly. But it is perhaps not proper to refer to the publication as a "book," it is rather an essay, and therefore an unbiased reader could not reasonably form an honest opinion on Mr. Bright's views unless he had an opportunity for considering also the views of others who may not be entirely in agreement with the author.

It is a difficult book to review, and the present writer is loath to express an opinion on Mr. Bright's views, but having read the book, and digested the arguments therein, albeit not necessarily in complete agreement with the author on certain points, he must say—being one of those interested

in the subject—that he is glad to have had the opportunity for reading in concise form all the arguments which have been put forward from time to time in favour of the State ownership and control of the lines of communication between Great Britain and her numerous dependencies. The work is not without certain topical interest at the present time, because of the discussions now current in connection with the administrative changes developing in regard to the control over the various Atlantic cables, which have since culminated in amalgamation of the interests involved in the present trans-Atlantic communications. The book also has interest in connection with the announcements regarding cable rates made by the Postmaster-General in Parliament recently.—R. M. H.

The "Cole" Code or Code Dictionary. By C. H. Cole. 1911. Rugby: *Rugby Advertiser*, Ltd. Price 10s. 6d.

This code provides what is difficult to find in others, viz., valuable matter in sentences, although it seems to lessen the full value of a code word, as there are numerous instances where one single word is represented by five letters. The recommendation in the introduction that prefixes should be used in order to secure secrecy is, as is generally known, of not much value, as they can be easily ascertained by those whose desire to do so.

There is useful matter in the code, such as a very full list of banks and places, but the fatal mistake is made of putting together groups of letters which, although pronounceable, are very difficult to transmit, and are, in consequence, a frequent cause of delay and mutilation of telegrams. Such words as Luvutcuvja, Vylletyggi, Lynytvudur, Jetubvytio, Manuhhujyk, Pefykuvsy, put a great tax on operators. We have on previous occasions drawn attention to this, and in our review of Mr. Sydney A. M. Rose's "Universal Code Economiser" we had cause to explain that such words defeat the object of a telegram, *i.e.*, to secure rapid and correct transmission.

In one instance we notice that "Perim" is a code word. Names of places should never figure as such, as it may be necessary to use them in their proper sense. Although it is stated that all the code words differ one from the other by two letters, such words as Corsi, Sorci, Comip, Pomic, Farip and Parif are found, which do not fulfil these conditions. There are facilities for economising in certain directions, but the method to be adopted appears somewhat confusing; given time and thought, however, cablers may find it a useful adjunct to their present codes.

Encyclopædia Britannica. 1910. Cambridge: *University Press.*

The eleventh edition of this work has been before the public for some months, but it takes time to go carefully through the important articles on technical subjects and to gain some sort of an idea about the whole scheme of the edition. It is, of course, now fully recognised that, in almost every respect, this extraordinary collection of the latest knowledge on all subjects represents something which the world has never seen before. In this remarkable year of 1911 one of the events has been the appearance of this work. Concerning the commercial side of the enterprise the writer has no concern, although it must be obvious to anyone that the tact and diplomacy which obtained the magic words "Cambridge University" must have been of no ordinary calibre. And the mind which organised the production of this library in epitome was certainly one which was working at its correct vocation. We have little to say about the general appearance of the volumes, but, personally speaking, we have found that the thin-paper edition is a great improvement on the older and bulkier volumes.

On comparing this edition with the tenth there are two or three outstanding impressions left on the mind of the applied scientist. One is that the importance of engineering and the allied industries to the national existence is now more fully appreciated. Another is that the three branches of applied science which seem to have developed most rapidly are aviation, electrical engineering and applied chemistry. So far as pure science is concerned, the readers of this journal will think the most interesting portions of the volumes are those devoted to physical science. Before passing on to the engineering sections, we will mention these.

Many of the articles which originally appeared within the covers of the "Encyclopædia Britannica," in connection with the physical sciences, have become classical. Among those who, in the past, have written for this work, may be mentioned the names of Lord Kelvin, James Clerk Maxwell and Lord Rayleigh, all of whom wrote for the ninth edition. Sir Joseph Larmor, Sir J. J. Thomson and Sir James Dewar wrote for the supplementary volumes. In this edition we find that Prof. Hugh L. Callendar has revised Lord Kelvin's original article on "Heat," while Prof. A. E. H. Love (of Oxford), has taken hold of the article on "Elasticity."

Apparently, valuable expert advice has been obtained upon the subjects dealing with physics. It has been kept in mind that an encyclopædia must not only be a collection of articles alphabetically arranged, but it must also present facts and theories of all branches of knowledge as a co-ordinated whole. Careful attention has evidently been paid as to the best manner in which subjects could be dissected into fitting and encyclopædic and scientific headings. For it was necessary that these headings should not be regarded by the expert with offence, but should give the layman a clue to the information required. The tremendous triumph in the whole scheme is the fact that, as far as one can tell after a few months' constant use of the volumes, no particular point has been omitted, and nothing seems to have been unnecessarily duplicated. In the articles in the physics section we recognise, from the initials at the ends of the articles, such giants as Rayleigh, Callendar, Poynting, Fleming and Larmor.

Readers of this journal are familiar with the present-day notion of matter. Considered apart from its state of aggregation, we believe it to be composed of molecules, which in turn are made up of atoms, and these are collections of electrons. Who could treat that subject as well as Sir J. J. Thomson? He directs the discussion to the establishment of the electronic theory. In view of the vast amount of work in this field for which he has been responsible, his present treatment is indeed welcomed.

As for the subject treated under "Aether," that article is built up on the foundations laid by Clerk Maxwell and Larmor, in the ninth and tenth editions. It is, fortunately, Larmor who continues the story. The latter also deals with the doctrine of energy under the title of "Energetics." We must pass lightly over the Sound and Light sections, but must mention Callendar's brilliant work on "Heat" and several allied subjects. A section on instruments is well done.

Dr. Watson adds some articles to those of earlier editions on "Magnetism." Dr. Fleming is responsible for all of the work on electricity. We may say that he has divided the subject matter essentially into four articles, viz., "Electricity," "Electrostatics," "Electrokinetics," and "Electromagnetism." The first-named heading contains an historical narrative of the development of the science, and indicates the co-ordination of the principal subsidiary headings.

As an example of what may be expected, we may mention the subject "Electrokinetics." The matter of electric conduction is reserved for one article under the heading "Conduction, Electric." But that is divided into three parts—(1) solids (by Prof. Fleming); (2) liquids (by Dr. Whetham), and (3) gases (by Sir J. J. Thomson). The last is, indeed, a complete monograph of the most authoritative nature.

We must not omit a reference to a series of articles on measuring instruments. In the preceding edition that omnibus title was used. Now we find headings "Amperemeter," "Voltmeter," "Wheatstone Bridge," and so on. All of these many articles are on a uniform plan, and typical in form. Very lucid are the explanations of the instruments. There is a deal of theoretical matter under the title of "Electrolysis."

And so one could go on dealing with these fascinating subjects. After all, if one were to review completely the scientific and technical articles, one would need many issues of the Electrical Review for the purpose. It is only possible to point out a few of the good things; the others are all up to the same standard.

We are indeed glad to note that Mr. C. C. Hawkins has been

responsible for the article on the dynamo—it is up to the style of his book. Dr. L. Bell writes on the electric motor. The "Accumulator" article is by Mr. W. Hibbert. Power stations and questions of supply are discussed by Dr. Fleming under "Electricity Supply." His account of the practical work is splendidly supplemented by Mr. E. Garcke, who writes on commercial development, legislation and those other matters of finance which he has made peculiarly his own. Similarly, we find Dr. Fleming and Mr. Garcke responsible for "Lighting, Electric." As for "Telegraph," we have Mr. H. R. Kempe on Section I—devoted to land and submarine, while Mr. Garcke deals with Section II—the commercial aspect. Dr. Fleming devotes his attention to Section III—on wireless.

The article on "Telephone" is by Kempe and Garcke. How interestingly the latter can make a story march.

If he were less optimistic, the work of this reviewer would seem to him almost to have been wasted. For he has read all of these articles, and many of those on education, applied chemistry, metallurgy, and all the other subjects, which some of us look at with interest, and study a little, but affectionately regard as a relaxation (for our work is really connected with engineering); and then there are so many engineering subjects not yet mentioned—"Railways," for example, a capital article; and Ewing at his best on "Heat Engines," Dugald Clerk on his subject, and so on. Of course, we cannot mention all of them. The result of the hours of study of these articles could be written down in a few words. It is, "This work is simply splendid." As for the Editor of the Engineering Section, one cannot fail to envy him his task so well completed, or to congratulate him upon what he has accomplished; work such as that lives for all time. It is not ephemeral, because others will build up from it. It will always last, although, as science and its applications advance, it must be frequently revised.

As for the non-technical aspect of the volumes—well, after all, engineers are intellectual members of society. It is true that many of us find it not over easy to raise the sum needed for these books; but there are many less satisfactory ways of spending money, and the day may come when the money will pay itself back because of something found within the covers.

FRICTION IN ELECTRICITY METERS: ITS DETERMINATION, COMPENSATION, AND RESULTANT ERRORS.

(Concluded from page 1045.)

Fig. 9, reduced to a common armature speed of 1 rev. per sec. (at which velocity windage friction becomes inappreciable), shows

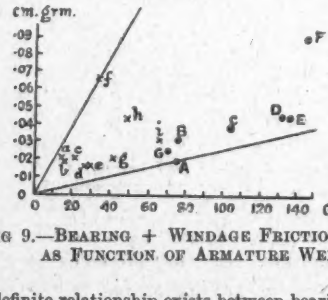


Fig 9.—Bearing + Windage Friction at 1 r.p.s. as Function of Armature Weight.

that no definite relationship exists between bearing friction and the weight of rotating parts supported.

Figure of Merit.—From the magnitude of the quotient—

$$P = \frac{\text{Full load driving torque}}{\text{Total frictional torque at full-load speed}},$$

an opinion may be formed as to the general merits of a given meter as regards frictional resistance. It is *not* advisable to replace this quotient by—

$$Q = \frac{\text{Full-load driving torque}}{\text{Armature weight}}$$

when comparing meters, particularly if, as is generally the case, the full-load speeds of the various instruments are very different.

In fig. 10 one quotient is represented by abscissæ, the other by ordinates, and it is clear that, were Q a suitable index of the total friction in meters with rotating armatures, the various points would show a definite connection with each other. Actually, however, among the meters here tested, $\tan \alpha_2 = 4{\cdot}6 \cdot \tan \alpha_1$ (fig. 10), *i.e.*, the ratio P/Q varies *without rule* between values which are to one another as 1 : 4·6.

Supplementary Measurements.—As the result of carefully conducted experiments, the author concludes:—

1. Windage torque between brake disk and braking magnet varies linearly with the speed (up to 0·7 m./sec. at least), and with

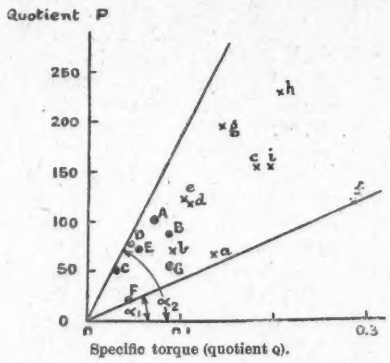


Fig. 10.—Total Friction and Specific Torque.

the air gap (at any specified velocity). In all practical cases this windage is negligible.

2. Errors in (bearing + windage) retardation tests, due to remanent magnetism in the meter cores may be avoided by exciting the field coils by a diminishing alternating current immediately prior to the test.

A method is described, whereby the moment of inertia of the armature system of a meter may be determined within ± 20 per

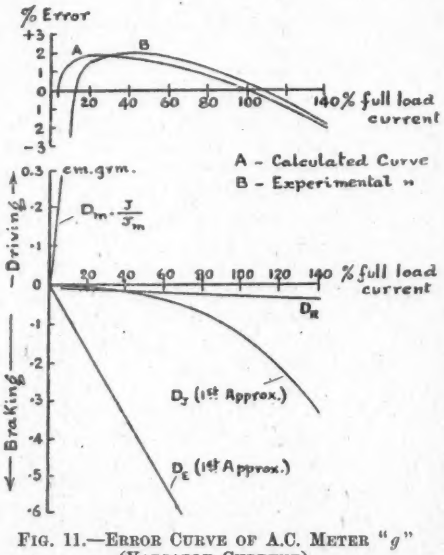


Fig. 11.—Error Curve of A.C. Meter "g" (Variable Current).

cent. by a retardation test. The oscillation method, already described, gives practically accurate results, and should be used whenever the armature system can be removed from the meter.

Compensation for Friction: Load-Error Curves.—In an elaborate mathematical section, the author discusses the theory of various means of meter compensation, and evolves equations whence the error curve of a meter may be predicted.

It is shown that the damping torques due to the stray fields from the current and voltage-circuits (D_J, D_E respectively) are given by—

$$\left.\begin{aligned} D_J &= C_J \cdot du/dt \cdot J^2 \\ \text{and } D_E &= C_E \cdot du/dt \cdot E^2 \end{aligned}\right\} \text{cm. grms.,} \quad \ldots \quad \ldots \quad (7)$$

(for meter "g", $C_J = 4{\cdot}67 \times 10^{-8}$; $C_E = 3{\cdot}29 \times 10^{-6}$ (C.G.S. units.))

The reliability of the equations deduced for the evaluation of meter error was tested by experimental verification of the predicted results. (See also Table IV.)

Alternating-Current Meter "g."—(a) Variable current, unity power-factor—the calculated and experimental error curves are as shown in fig. 11. At the higher loads good agreement is certain, but at low loads discrepancies arise owing to the impossibility of observing the friction compensating and light load resisting torques with sufficient accuracy. By adjusting the friction compensation, the error curves of the meters here examined could be brought to almost any desired form up to 50% full load.

(b) Variable power-factor, constant current and pressure—comparative results shown in fig. 12. The calculated curve makes no allowance for friction compensation.

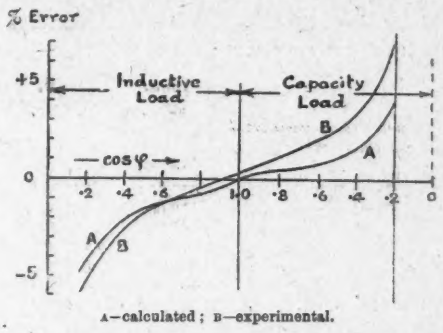
TABLE IV.—Extracts from Data for Error Curves (Figs. 11, 12, 13).

TABLE IV.—Extracts from Data for Error Curves (Figs. 11, 12, 13).

Case.	General data.	Cos φ.	Current I. % Imax.	Current I. Amps.	$\frac{d\alpha}{dt}$ (R.P.S.).	Resisting torques (cm. grm.). D_R	D_E	D_I	D_K	$(D_R - D_K)$ cm. grm.	$(D_R + D_E + D - D_K)$ cm. grm. 1st appr.	$(D_R + D_E + D - D_K)$ cm. grm. 2nd appr.	Error F_d (%) 1st appr.	Error F_d (%) 2nd appr.	Error F_b (%) 1st appr.	Error F_b (%) 2nd appr.	Error F (%). By Expt.
A.—Fig. 11. A.C. meter "g." Variable load.	500 v. 5 a. 50 ~ meter. Max. torque, 5·29 cm. grm. Max. R.P.S., 1·042. $\delta' = 0° 30'$. D_R — see figs. 6, 7, 8. $C_E = 3·29 \times 10^{-6}$. $C_I = 4·67 \times 10^{-8}$. K = 1·233.	1·00	4	0·2	·0417	·0058	·0343	0	0	—	·0401	—	— 19·0	— 18·9	— 0·1	0	—
			20	1·0	·208	·0080	·172	·001	0	—	·1810	—	— 17·1	— 17·5	+ 2·2	+ 1·7	+ 1·5
			60	3·0	·625	·0149	·515	·0262	0	—	·556	—	— 17·6	— 17·8	+ 1·6	+ 1·3	+ 1·7
			100	5·0	1·042	·0233	·857	·122	0	—	1·002	—	— 18·9	— 18·9	0	0	+ 0·3
			140	7·0	1·46	·0330	1·20	·334	0	—	1·002	—	— 18·9	— 20·3	— 4·2	— 1·7	— 1·5
B.—Fig. 12. A.C. meter "g." Variable power factor.	Ditto Case *A*.	*Lagging* 0·8	100	5	·834	·0186	·686	·097	0	—	·802	—	K.F_d — 23·4	K.F_d — 23·2	— 0·9	— 0·7	— 0·5
		0·2	100	5	·208	·008	·171	·024	0	—	·203	—	— 23·6	— 22·4	— 5·5	— 4·3	— 5·3
		Leading 0·8	100	5	As for inductive load.				·035	—	·802	—	— 23·4	— 23·6	+ 0·8	+ 0·6	— 1·4
		0·2	100	5						—	·203	—	— 23·6	— 24·8	+ 5·0	+ 3·8	— 7·0
C.—Fig. 13. D.C. meter "D." Variable load.	65 v. 3 a. meter. Max. torque, 5·76 cm. grm. Max. speed, 0·969 R.P.S. D_R — see figs. 6, 7, 8. $C_E = 1·01 \times 10^{-6}$. $C_H = 1·13 \times 10^{-4}$. K = 1·000.	1·00	3·3	0·1	·0323	·014	—	—	◄—— ·009 ——►	—	—	—	— 4·7	— 4·6	In this case $F_b = F_d$ throughout (see text).	— 4·6
			20	0·6	·1938	·050	—	—	·015	—	—	—	— 1·3	— 1·3			— 1·3
			60	1·8	·5814	·061	—	—	·026	—	—	—	— 0·8	— 0·7			— 0·7
			100	3·0	·969	·073	—	—	·038	—	—	—	— 0·7	— 0·7			— 0·7
			140	4·2	1·357	·089	—	—	·054	—	—	—	— 0·7	— 1·3			— 1·3

Unnecessary (see text).

Direct-Current Meter "D."—Concordance of calculated and experimental load-error curves is shown in fig. 13. The earth's field may vary the net torque due to the friction-compensating series



A—calculated; B—experimental.

Fig. 12.—Error Curve, A.C. Meter "*g*." Variable cos φ.

coil by more than 30 per cent. on turning the meter through 180°. Since the compensating field has a great influence on the meter error at low speeds, it is highly important that the present type of meter be calibrated *in situ* or at least with the same disposition of the instrument, relatively to the earth's field, as will obtain in the subsequent use of the instrument.

TABLE III.—Moment of Inertia of Armature System (by "Coasting" and "Oscillation" Methods).

Meter.	Current and voltage as per cent. of normal. J_1	J_2	E	Error in mt. inertia by coasting test. (Taking K by oscillation test to be correct).
c	6	0	20	— 3 %
	8	0		— 12 %
B	4	0	100	+ 9 %
	2	0		+ 10 %
	4	2		+ 8 %
C	5	0	100	— 25 %
	3	0		— 21 %
	6	0	100	— 2 %

Conclusions.—Modern A.C. meters of the Ferraris type show so small a total frictional resistance that the provision of a constant compensating torque adequately corrects error due to this cause.

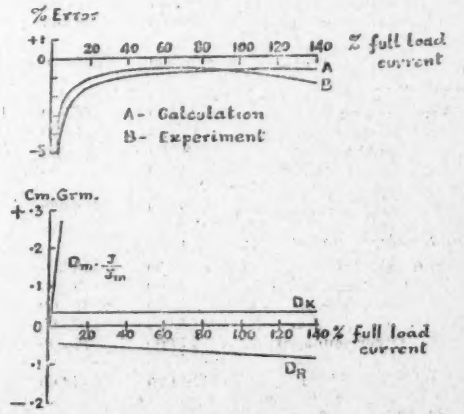


Fig. 13.—Error Curve, D.C. Meter "D." Variable Current.

Direct-current watt-hour meters are seriously affected by friction at low loads. Good compensation is possible, on constant-voltage circuits, by the provision of a constant correctiog torque, but owing to the powerful influence of the earth's field, the total frictional torque should be as low as possible. Brush and clockwork friction are specially serious, bearing and windage friction vary with the armature speed and do not seriously affect the error curve. The constant frictional resistance in ampere-hour meters should be a minimum, its compensation being a complicated matter.

All meters with rotating armatures should have a low running speed; the fulfilment of this condition in A.C. meters reduces the damping error due to stray alternating fields.

TRADE STATISTICS OF HOLLAND.

The following figures, showing the imports of various goods into Holland in 1910, are taken from the recently issued annual trade statistics; the figures for 1909 are added for purposes of comparison, and notes of any increases or decreases are given:—

	1909. Gulden.	1910. Gulden.	Increase or decrease. Gulden.
Machinery, steam, industrial and agricultural.—			
From Belgium	1,948,000	2,487,000	+ 539,000
„ Great Britain ...	5,676,000	5,779,000	+ 103,000
„ Hamburg	158,000	117,000	— 41,000
„ Germany	14,101,000	15,468,000	+1,367,000
„ United States ...	2,278,000	2,747,000	+ 469,000
„ Other countries ...	249,000	297,000	+ 48,000
Total ...	24,410,000	26,895,000	+2,485,000
Gutta-percha, raw.—			
From France	173,000	103,000	— 70,000
„ Great Britain ...	12,000	202,000	+ 190,000
„ Dutch Guiana ...	882,000	655,000	— 227,000
„ Java	1,598,000	5,077,000	+3,479,000
„ Other countries ...	286,000	410,000	+ 124,000
Total ...	2,951,000	6,447,000	+3,496,000
Gutta-percha manufactures.—			
From Belgium	525,000	477,000	— 48,000
„ Great Britain ...	446,000	515,000	+ 69,000
„ Germany	497,000	608,000	+ 111,000
„ Other countries ...	10,000	156,000	+ 146,000
Total ...	1,478,000	1,756,000	+ 278,000
Iron wire.—			
From Belgium	3,003,000	3,197,000	+ 194,000
„ Great Britain ...	3,000	25,000	+ 22,000
„ Germany	21,759,000	20,279,000	—1,480,000
„ Sweden	136,000	166,000	+ 30,000
„ Other countries ...	3,000	52,000	+ 49,000
Total ...	24,904,000	23,719,000	—1,185,000
Instruments, physical, chemical, &c.—			
From Belgium	587,000	532,000	— 55,000
„ Great Britain ...	379,000	484,000	+ 105,000
„ Hamburg	84,000	39,000	— 45,000
„ Germany	3,753,000	4,554,000	+ 801,000
„ Other countries ...	83,000	99,000	+ 16,000
Total ...	4,886,000	5,708,000	+ 822,000
Copper wire.—			
From Belgium	186,000	123,000	— 63,000
„ Great Britain ...	104,000	96,000	— 8,000
„ Hamburg ...	417,000	154,000	— 263,000
„ Germany	2,679,000	2,494,000	— 185,000
„ Other countries ...	22,000	68,000	+ 46,000
Total ...	3,408,000	2,935,000	— 473,000
Steel wire.—			
From Belgium	1,922,000	446,000	—1,476,000
„ Great Britain ...	447,000	644,000	+ 197,000
„ Germany	2,399,000	1,595,000	— 804,000
„ Other countries ...	22,000	21,000	— 1,000
Total ...	4,790,000	2,706,000	—2,084,000
India-rubber manufactures.—			
From Belgium	199,000	238,000	+ 39,000
„ Great Britain ...	1,379,000	2,083,000	+ 704,000
„ Germany	1,274,000	1,981,000	+ 707,000
„ United States ...	15,000	20,000	+ 5,000
„ Other countries ...	17,000	70,000	+ 53,000
Total ...	2,884,000	4,392,000	+1,508,000
Glass manufactures.—			
From Belgium	245,000	271,000	+ 26,000
„ Great Britain ...	97,000	103,000	+ 6,000
„ Germany	1,653,000	1,902,000	+ 249,000
„ Other countries ...	9,000	13,000	+ 4,000
Total ...	2,004,000	2,289,000	+ 285,000
Porcelain.—			
From Belgium	141,000	151,000	+ 10,000
„ Great Britain ...	52,000	48,000	— 4,000
„ Germany	987,000	1,104,000	+ 117,000
„ Other countries ...	36,000	49,000	+ 13,000
Total ...	1,216,000	1,352,000	+ 136,000

Note: Gulden = 1s. 8d.

THE JUNIOR INSTITUTION OF ENGINEERS: SUMMER MEETING IN EAST ANGLIA.

It was but natural that with Sir J. J. Thomson, Professor of Experimental Physics at the University of Cambridge, as President, the summer meeting of the progressive Junior Engineers should, this year, have had its setting in East Anglia, with visits to the Laboratories of Physics and Engineering at Cambridge as the gem of the week so to speak.

In accordance with usual custom, the members foregathered at a place where the week-end previous to the opening of the meeting could be spent in quite a holiday fashion. Thus it came about that on Saturday, July 29th, the Felix Hotel at Felixstowe opened its hospitable portals to the Institution, and was constituted the headquarters of the party until the following Monday morning, by which time the introduction period had been well got over, and the greatest possible good fellowship prevailed throughout. The Cinderalla dance at the hotel on the Saturday evening provided most opportunely the occasion for the ladies of the party to enter into acquaintanceship, and appeared to be fully appreciated.

Ipswich was the first town of call, and was reached by a pleasant steamer trip from Felixstowe up the River Orwell. On arriving, the directors of Messrs. Ransomes & Rapier met the members and conducted them over the well-known Waterside Ironworks, while the ladies were appropriately shown round the corset manufactory belonging to Messrs. W. Pretty & Sons. At the former works the application of electrical power was well illustrated. The generating station consists of separate engine room and boiler-house. There are three direct-coupled, steam-driven sets, two of which have an output of 100 KW. each, and the other set 200 KW., at 230 volts. A testing set of variable voltage and current for use in the testing of electric cranes was examined with great interest. For running the generating plant, steam at a pressure of 150 lb. per sq. in. is supplied from three boilers fitted with an economiser. The manner in which the final erection and testing of cranes in the yard is carried out by means of various travelling steam cranes was shown.

After their morning's perambulation, the members and their fair friends were entertained at the Crown and Anchor Hotel by Messrs. Ransomes & Rapier, Ltd., the chairman and managing director, Mr. Wilfrid Stokes, M.Inst.C.E., presiding at the luncheon. The occasion was marked by the presence of the Mayor of Ipswich, Mr. P. W. Cobbold, the borough engineer, and other gentlemen.

Mr. H. S. Jefferies, M.I.Mech.E., of Messrs. Ransomes, Sims and Jefferies, then took the party in hand for the afternoon, conducting them to the Orwell Works, where were seen in course of production numerous traction engines, road locomotives, portable and stationary engines, electric overhead traversing cranes, &c.

While the members were thus occupied, the ladies were engaged in inspecting some of the historic places of interest for which Ipswich is celebrated, afterwards joining the members for afternoon tea at the Crown and Anchor Hotel, as guests of Messrs. Ransomes, Sims & Jefferies. The acknowledgments of the Institution having been expressed to them for opening their works for visiting, the party subsequently joined the 6.28 p.m. Cromer express from Ipswich for Norwich, where the old-fashioned and interesting Maid's Hotel became headquarters.

On the following morning (Tuesday), Mr. Thomas Glover, M.Inst.C.E., the engineer and general manager of the Norwich works of the British Gas Light Co., acted as cicerone over his works, the annual production of which exceeds 420 million cb. ft. The *pièce de résistance* here proved to be the De Brouwer combined charging and discharging machine, an ingenious apparatus, the invention of M. de Brouwer, engineer in charge of the gasworks at Bruges. Electrical engineers present did not fail to note how electricity had been brought into service in the working of this machine. All the motors are of the enclosed type. Their position on the machine is arranged as far away from the retort bench as possible, and the projector motor is enclosed in a box. The current is supplied from a 37-KW. generator, of Messrs. Laurence, Scott & Co.'s construction, the same generator also supplying the motors which drive the coke conveyors.

The current is conveyed to, and returned from, the machine by overhead bare cables and trolley arms at 220 volts pressure. It passes from the overhead positive cables by way of the trolley arms to vertical cables within the framework of the machine. Contact is made with these vertical cables as the hanging frame is raised and lowered, by means of other contact arms provided with rollers, as on the overhead trolley arms. The current next passes through a circuit-breaker, which acts as a safeguard for all motors on the machine. After passing through the circuit-breaker the current goes to the various controllers and motors and back to the negative overhead cable.

Within the framework of the machine a hanging frame is suspended upon suitable chains, which framework is capable of being raised and lowered to suit the various tiers of retorts to be charged. The charging drum is fitted within this frame, and is 40 in. diameter × 15 in. across, the periphery being grooved 8 in. × 8½ in. The rubber belt on which the coal falls, and by means of which it is projected into the retorts, passes round pulleys and partly round the drums. The top pulley is capable of being raised to maintain the tension and to take up the stretch. The discharging part of the machine works alongside the charging apparatus, and consists of two steel channels telescoping one within the other. The whole discharger is capable of being lifted and lowered to suit the varying tiers of retorts in the same way as the position of the charging portion is adjusted.

The programme for the ladies during the members' inspection of these works consisted of a series of visits by motor-car to places of civic interest. They afterwards assembled with the members to partake of refreshments offered by the chairman and directors of the British Gas Light Co. The whole party then proceeded to Norwich Castle to visit the well-known museum, &c., and the cathedral, where the afternoon service was attended.

Wednesday was given up entirely to "a day on the Broads," and a very enjoyable day everyone pronounced it to be. The Horse Shoes Hotel, picturesquely situated on the river at Wroxham, proved an excellent place of embarkation, its cuisine for luncheon and afternoon tea leaving nothing to be desired.

On the following morning the Carrow Works of Messrs. J. & J. Colman, where the mustard, starch and blue come from, provided means for the examination of numerous processes in which electrical, mechanical and other species of the genus engineer could not fail to be deeply interested, as well as those having proclivities towards the study of the social condition of workers in large factories. A call was made at the company's Club House—a long building standing in a neatly cultivated garden. There is a fine central hall accommodating 500 persons, billiard room, gymnasium, &c., so that the social needs of the employés are well considered. The party then made their way to the Criterion Restaurant for luncheon as the guests of Messrs. J. & J. Colman. At 5 o'clock the party left Norwich for Cambridge, arriving there in time for dinner at the University Arms Hotel, the final headquarters for the week.

Friday's proceedings will long be remembered, for the reason that the party spent most of the day in the company of the President, Sir J. J. Thomson. The memory of his kindness and friendliness to everyone will be cherished by all who had the privilege of being present. On arriving at the Hopkinson Laboratory in the morning the President introduced Prof. Bertram Hopkinson, Professor of Mechanism and Applied Mechanics in the University of Cambridge, who showed the party over his department, after which the President conducted some striking experiments in the physical laboratory, including demonstrations of the action of liquid air, and of high-tension electric currents. The laboratories are fully equipped with apparatus and appliances of all kinds, the operation and uses of which were exhaustively explained, for which both the President and Prof. Hopkinson were warmly thanked before the visitors left.

The Council Chamber of the Guildhall was the next rendezvous, where the party were entertained to luncheon by the Mayor, an organ recital following.

In the afternoon all the beauty and capacity of expression of the organ, for which Trinity Chapel is so noted, was exemplified in a special recital given in honour of the Institution's visit, by Dr. Alan Gray. It was a remarkable performance, and gave real pleasure to all, especially those devotees of music, of whom there are not a few in the ranks of the Institution. Afterwards followed, under escort of the President, visits to Trinity Dining Hall and Library, and to several of the colleges. The unaccompanied service in King's was attended as the concluding item of the afternoon's programme.

The Institution's summer dinner was held at the University Arms Hotel in the evening, Sir J. J. Thomson presiding. Amongst the guests were Sir Joseph Larmor, M.P., the Mayor of Cambridge, Dr. Alan Gray and Prof. M'Lennan, Professor of Engineering in the University of Toronto. After observing the loyal toasts, that of "The University and Town of Cambridge, and the Proprietors of the Works, &c., opened to the Visit of the Institution during its Summer Meeting in East Anglia," was proposed by Mr. S. Bylander, and was acknowledged by Sir Joseph Larmor, the Mayor of Cambridge, and Mr. Thomas Glover, of Norwich. "The Universities of our Dominions Beyond the Seas" was proposed by the President, who spoke in eulogistic terms of all that was being done in the Colonies for students of engineering. Prof. M'Lennan, in responding, admitted that they were very proud of their engineering school at Toronto, but said there were matters on the practical side of engineering to which they might give more attention. One was in respect of the ventilation of their buildings, in which Great Britain was far ahead of them. Another was the finish and permanence of their works. They had much to learn as to the supply of water to their large cities. Typhoid fever was prevalent in the large towns, and at Toronto, whilst they were on the banks of a lake 200 miles long and 40 miles broad, the public water supply was so bad that they had to drink distilled water. The concluding toast, "The Institution," was given by Mr. J. W. Auchterlonie, and was replied to by Mr. B. E. Dunbar Kilburn. The toasts were interspersed with musical selections given by the Chorister Glee Singers.

The works of the Cambridge Scientific Instrument Co. were visited on the following morning. Here were seen various types of pyrometers, thermometers and mechanical and electrical instruments in course of construction, including the Duddell oscillograph, the Einthoven galvanometer, and the Duddell thermo-galvanometer.

A garden party was given in the afternoon by the President and Lady Thomson at their home in West Road, forming a most agreeable termination to a week full of technical interest and social enjoyment, which the Junior Engineers seem to have the faculty of so happily blending in all they undertake.

NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

A Sign Projector.

A recent issue of the *Central Station Engineer* describes an electric sign projector which is exceedingly simple in construction. Its essential features are a powerful little lamp, three lenses and a stencil containing the advertisement.

The lamp, which is a 100-C.P. of the glower type, operates on the regular lighting circuit, either A.C. or D.C.

The lenses, the glower and the stencil are contained in a metal tube, 14 in. long and 2¼ in. in diameter.

The tube is separated at the end occupied by the lamp so as to provide for the insertion of a small globe, which makes the light available for illuminating the window in which the sign projector is placed. The pedestal for the tube to rest upon completes the outfit, which is illustrated in fig. 1.

Fig. 1.—Electric Sign Projector

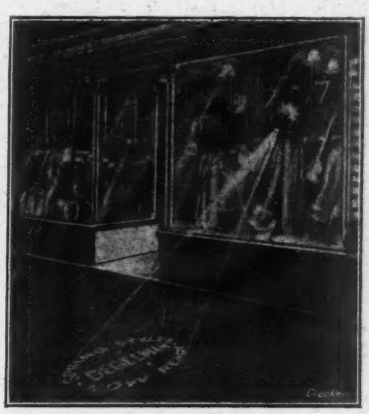


Fig. 2.—The Projector in Use.

It can be placed on a bracket or attached directly to the ceiling, in the window, above the door, or in any convenient place. The tube may be adjusted to suit the position and height, being capable of adjustment to any angle. It is focused like an opera glass.

The advertisement as it appears on the pavement is not round as shown on the stencil, but slightly elliptical (fig. 2). It varies from 3½ ft. longest diameter upwards, according to the distance of the projector above the sidewalk.

While primarily intended for pavement advertising, the projector may be used for throwing advertisements on walls and ceilings as well. It has been effectively used by department stores as a wall sign to call attention to special sales.

This sign projector is manufactured by the Pittsburg Electric Specialties Co.

OUR LEGAL QUERY COLUMN.

[*Questions addressed to this column should be written on one side of the paper only.*]

"A. J. H." writes:—"A person owns a house, and has a right of way thereto. However, the railway company owns the roadway and footway by which the house is approached. Has the owner of the house necessarily a right to open the footway or roadway for the purpose of having drains, water, gas or electric services laid or repaired? It seems to me that if a person purchases property with a right of way thereto, it is only reasonable to assume that he has the right to lay the necessary services to be able to enjoy his property.

"Also, if he cannot break the surface, would he have the right to swing service wires or pipes overhead?"

*** A right of way imports nothing more than the words intend. It confers no property in the soil. The public have a right of way along a high road—that is to say, they may pass and repass; but they may not camp out on the road, or tear up the surface, or suspend wires over or across it. A private right of way confers no greater privileges. The right to uproot and lay drains, &c., is vested in the owner of the soil, unless, of course, there is a right to drain as well. In the circumstances, it appears that the person referred to by "A. J. H." cannot have the necessary services.

Llanelly Tramways. — One hundred tramway men struck work on the 21st inst., demanding recognition of the union.

NEW PATENTS APPLIED FOR, 1911.

(NOT YET PUBLISHED.)

Compiled expressly for this Journal by MESSRS. W. P. THOMPSON & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford, to whom all inquiries should be addressed.

27,748. "Electric resistance grids." ELECTRIC AND ORDNANCE ACCESSORIES Co., LTD., and M. R. H. MUELLER. December 11th.

27,801. "Electric current-limiting devices." H. B. E. NORDFELDT. December 11th. (Complete.)

27,808. "Dynamo-electric machines." P. TAYLOR-BATTEN. December 11th.

27,817. "Self-regulating arc lamps." PHYSIKALISCHES LABORATORIUM MECHANISCHE-TECHNISCHE WERKSTATTE HANS THOMA G.M.B.H. (Convention date, December 12th, 1910, Germany.) December 11th. (Complete.)

27,826. "Electric safety lamp." H. SEFTON-JONES. (Electric Exporte Werke G.m.b.H., Germany.) December 11th. (Complete.)

27,840. "Means for transmitting rotary motion." JANDUS ARC LAMP AND ELECTRIC Co., LTD., and A. D. JONES. December 11th.

27,842. "Electrically heated thermal accumulator." A. RITTERSHAUSSEN. December 11th. (Complete.)

27,848. "Electric motor-generators." ELECTRIC AND ORDNANCE ACCESSORIES Co., LTD., and H. V. BOWEN. December 11th.

27,862. "Series systems of incandescent lamp lighting." E. BOOTH and N. R. BOOTH. December 12th.

27,869. "Miners' safety lamps and ignition devices in connection therewith." E. A. HAILWOOD. (Addition to 14,914/1909.) December 12th.

27,883. "Electrical heating of service or dinner lifts." F. HODGSON. December 12th. (Complete.)

27,884. "Manufacture of electric metallic-filament lamps." G. MIDGLEY and A. R. CROSSLEY. December 12th.

27,902. "Process and apparatus for electrically decomposing fluids." L. G. FIXEN. December 12th. (Complete.)

27,910. "Electric safety lamps." K. G. H. VON SLADEN VOGELSBERGER. December 12th.

27,931. "Processes of separation by aid of electro-osmosis." G. B. SCHWERIN. (Convention date, January 25th, 1911, Germany. Addition to 3,864/1911.) December 12th. (Complete.)

27,932. "Distributing system for explosion engines." ITALA FABBRICA DI AUTOMOILL. (Addition to 19,455 of 1911. Convention date, June 17th, 1911, Italy.) December 12th. (Complete.)

27,951. "Method and apparatus for producing a gaseous reaction by a silent discharge." BRITISH THOMSON-HOUSTON Co., LTD. (General Electric Co., United States.) December 12th.

27,953. "Telephone relays." S. G. BROWN. December 12th.

27,974. "Apparatus for indicating at the power station a fault or leakage of current and its particular location in a series of electric mains or conductors." R. HACKING. December 13th.

27,978. "Apparatus for photometrically testing burners for gas or electricity." W. GORDON. December 13th.

29,988. "Electric alternating current or voltage measuring or detecting instruments." C. E. K. MEES and A. F. C. POLLARD. December 13th.

27,995. "Electric fuse handles." SYKES & SUGDEN, LTD., and A. SUGDEN. December 13th.

28,007. "Enumeration of telephone calls." S. D. WILLIAMS. December 13th.

28,023. "X-ray apparatus." H. A. C. DONNITHORNE and W. HAMPSON. December 13th.

28,054. "Electric miners' lamps." W. CROSS. (Dr. Zodzislav Stanecki, Fabryka akummulaturow i przyrzadow elektrycznych, Spolka z ograniczona odpowiedzialnoscia Lwow, Austria.) December 13th. (Complete.)

28,060. "Portable lamps for electric lighting." E. MURRLE. December 13th.

28,137. "Dynamo-electric machines for use in electric generative systems of motor vehicles." B. BROOKS and W. HOLT. December 14th.

28,165. "Intercommunicating telephone systems." W. FAIRWEATHER. (K. M. Turner, U.S.) December 14th. (Complete.)

28,185. "Electro-osmotic processes." GES. FUR ELEKTRO OSMOSE M.B.H. (Convention date, September 28th, 1911, Germany.) December 14th. (Complete.)

28,199. "Electric circuit protective devices." BRITISH THOMSON-HOUSTON Co., LTD. (General Electric Co., United States.) December 14th.

28,209. "Mechanism for striking and controlling the electric arc." H. E. CROCKER. December 14th.

28,221. "Step-by-step motion for electric controller, rheostats, and similar devices." F. GREENHALGH. December 15th.

28,236. "Electric pendulum or revolving wheel." A. SCHMIDT. December 15th.

28,263. "Arrangement for working in parallel of synchronous and asynchronous alternating-current generators." SIEMENS BROS. DYNAMO WORKS, LTD. (Siemens Schuckertwerke G.m.b.H. Germany.) December 15th. (Complete.)

28,281. "Means for generating electricity." L. DUCELLIER. December 15th.

28,285. "Vapour electric devices." BRITISH THOMSON-HOUSTON Co., LTD. (General Electric Co., United States.) December 15th.

28,321. "Devices for giving a signal and indicating the number of calls on telephones." H. WILKINS. December 16th.

28,351. "Production and wireless transmission of electrical oscillations." H. HEINICKE and M. JAEGER. December 16th.

28,383. "Dynamo-electric induction and like machinery." AKT.-GES. BOVERI ET CIE. (Convention date, December 16th, 1910, Germany.) December 16th. (Complete.)

28,391. "Electric distribution systems." J. BIJUR. (Convention date, December 21st, 1910, United States.) December 16th. (Complete.)

PUBLISHED SPECIFICATIONS.

Copies of any of the Specifications in the following list may be obtained of MESSRS. W. P. THOMPSON & Co., 285, High Holborn, W.C., and at Liverpool and Bradford; price, post free, 9d. (in stamps).

1910.

METHOD OF PRODUCTION AND UTILISATION OF HYPER-ULTRA-VIOLET RADIATIONS HAVING WAVES OF SHORT LENGTH FOR STERILISATION PURPOSES. R. Lillon Daguerre. 24,025. October 25th. (October 18th, 1909.)

MEANS OF CARRYING BRUSHES FOR ELECTRIC MACHINES AND HOLDING THEM UP TO THEIR WORK IN THEIR ELECTRICAL CONNECTIONS. Electrical Construction Co. and N. Pensabene. 27,205. November 23rd.

ELECTRICAL CURRENT GENERATORS. A. E. R. Bottone. 28,611. December 8th.

CROSSINGS AND LIKE FITTINGS FOR ELECTRICAL CONDUCTORS. F. M. Munro and Railless Electric Traction Co. 29,706. December 21st.

ELECTRICALLY-DRIVEN CLOCKS AND OTHER ELECTRICALLY-DRIVEN RUNNING MECHANISMS. A. M. Lowne and Lowne Electric Clock and Appliances Co. 27,293. November 23rd.

MINERS' ELECTRIC SAFETY LAMPS. O. Oldham. 27,641. November 28th.

COUPLINGS FOR TROLLEY WIRES AND OTHER ELECTRICAL CONDUCTORS. A. Mather and R. Barlow. 27,711. November 29th.

METHOD OF SYNCHRONISING ELECTRIC OR OTHER MOTORS FOR USE ON CRANES, HOISTS, GUN TURRETS, OR OTHER MACHINERY. Sir W. G. Armstrong, Whitworth & Co. and F. Harlow. 27,814. November 30th.

ELECTRIC HEATERS. H. J. Read. 27,954. December 1st.

ELECTRICALLY-INSULATING COMPOUND AND PROCESS OF PREPARING THE SAME. O. V. Thomas. 28,069. December 2nd.

REVERSIBLE VARIABLE-SPEED DYNAMO. J. Mould. 28,307. December 6th.

APPARATUS FOR CONTROLLING GAS-COCKS AND ELECTRIC LIGHT SWITCHES. B. Scheidemann. 29,125. December 15th.

BAYONET-JOINT FASTENINGS FOR ELECTRIC LAMPHOLDERS AND FOR OTHER PURPOSES. E. Cheadle. 29,425. December 19th.

1911.

ELECTRODES FOR ELECTRIC ARC LAMPS. S. Conradty and B. Conradty. 14,722. June 25th.

DRIVING OF ROTARY FIELD INDUCTION MOTORS. Siemens-Schuckertwerke Ges. 17,768. August 4th. (August 4th, 1910.)

TELEPHONE RECEIVERS. Western Electric Co. (Western Electric Co.) 17,975. August 5th.

ELECTRICAL TRANSFORMERS. E. Haefely. 20,624. September 16th.

APPARATUS FOR THE PURIFICATION OF ELECTROLYTIC GASES. A. E. Knowles. 21,600. September 30th.

APPARATUS FOR STERILISING LIQUIDS BY ULTRA-VIOLET RAYS. A. Helbronner and A. von Recklinghausen. 21,629. October 30th. (Divided application on No. 23,078 of 1910. May 1st, 1911.)

ELECTRICAL PURIFICATION OF GASES AND APPARATUS THEREFOR. J. Y. Johnson. (Badische Anilin & Soda Fabrik.) 60. January 2nd.

ELECTRIC CIRCUIT CONTROLLING DEVICES. British Thomson-Houston Co. (General Electric Co.) 178. January 3rd.

CONTROLLERS FOR ELECTRICALLY-DRIVEN MOTOR VEHICLES. A. Pieper. 1,776. January 24th. (January 25th, 1910.)

ELECTRICAL INFLUENCE MACHINES, OR MACHINES FOR PRODUCING STATIC ELECTRICITY. Morris & Lister, Ltd., D. K. Morris and F. A. Watson. 2,591. February 1st.

CURRENT-COLLECTORS FOR ELECTRICALLY-PROPELLED VEHICLES. F. M. Munro and Railless Electric Traction Co. 2,889. February 4th.

SMELTING FURNACE WITH ELECTRIC REFINING HEARTHS CONNECTED THERETO. A. Helfenstein. 5,140. March 1st. (March 10th, 1910.)

AUTOMATIC ARC LAMP FOR LIGHT PROJECTIONS. A. Blondel. 5,562. March 4th.

ELECTRICAL SWITCHES AND CONTROLLERS. F. Garside. 5,856. March 8th.

CONTROL OF ELECTRICALLY-OPERATED SWITCHES. British Thomson-Houston Co. (General Electric Co.) 6,663. March 16th.

SPEED CONTROL OF ELECTRIC MOTORS. Siemens Bros. Dynamo Works, Ltd., and N. Lydall. 8,591. April 4th.

IMPEDANCE COIL FOR TELEPHONY AND LIKE SYSTEMS. E. A. Graham and W. J. Ricketts. 10,045. April 25th.

STATIC FREQUENCY CONVERTER. O. Imray (administrator of the estate of M. L. Joly, deceased). 11,526. May 12th. (May 17th, 1910.)

TELEPHONE AND OTHER MOUTHPIECES. L. Steinberger. 13,641. June 7th. (June 13th, 1910.)

TELEPHONE RECEIVER HOLDERS. C. S. Bann. 13,948. June 12th.

TERMINALS FOR INSULATED ELECTRIC WIRES. A. Morgan. 15,091. June 23th.

ELECTRIC SAFETY FUSES. R. Kallmann. 15,646. July 7th. (Divided application on No. 16,258 of 1910, October 18th.)

CLUTCH MECHANISM FOR THE DETACHABLE ATTACHMENT OF AN ARC LAMP OR OTHER APPLIANCE TO A POST OR HIGH-UP SUPPORT OR SUSPENDER. N. Worsley. 15,862. July 8th.

ELECTROCUTING TRAP. H. Hertzberg, A. A. Low and W. J. Wohl. 16,065. July 11th.

FUSES FOR ELECTRIC CIRCUITS. E. A. Graham. 16,228. July 13th.

ELECTRICAL SECONDARY OR STORAGE BATTERIES. W. Bayer and B. Hubbard. 16,859. July 22nd.

MANUFACTURE OF MAGNETIC ELECTRODES. Chemische Fabrik Buckau. 16,902. July 24th. (July 22nd, 1910.)

METHOD OF AND DEVICE FOR LOCKING THE HIGH-TENSION CHAMBER OF ELECTRICALLY-DRIVEN VEHICLES. Allgemeine Elektricitats-Ges. 17,301. July 28th. (August 18th, 1910.)

CIRCUIT ARRANGEMENTS FOR RAILWAY POINTS AND SIGNALS. Siemens Bros. and Co. (siemens & Halske Akt.-Ges.) 18,293. August 12th.

MOUNTINGS FOR WALL-TELEPHONE SETS. Siemens Bros. & Co. (Siemens and Halske Akt.-Ges.) 18,462. August 15th.

RAILWAY OR LIKE SIGNALS. Siemens Bros. & Co. (Siemens & Halske Akt.-Ges.) 18,776. August 21st.

SAFETY SUPPORT FOR ELECTRIC OVERHEAD WIRES. G. Gottschalk. 543. January 9th.

ARC LAMP ELECTRODES. British Thomson-Houston Co. (General Electric Co.) 710. January 10th.

Factory Buildings Sales.—In their review of Factory and Commercial Property Sales during 1911, MESSRS. LEOPOLD FARMER & SONS report better results than in 1910 in the disposal of factory property, wharves, land, &c. There is a migratory movement amongst manufacturers to districts outside large towns where the lowest possible cost of manufacture can be obtained. It is difficult to say which branch of any particular manufacture more than any other has progressed in the year 1911; one, however, perhaps being very noticeable, is the manufacture of electric metal-filament lamps, and several companies interested in the business have acquired factories and are carrying on large businesses. Development has taken place in the motor and rubber trades, factories having been opened in consequence for manufacturing purposes. The acquiring of factories, &c., and building of works, consequent on reorganisation and extension in many trades, are always in progress; such operations in the engineering, milling, chemical and spinning trades having been well to the front in the year under review. The areas most sought after are those which offer the best facilities for manufacture on the lowest possible basis of cost of production. The effects of the Patents and Designs Act continue to be well to the front, foreign holders of English patents still being on the look out for factory property to comply with its requirements.

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See Sup. 9 to 13.

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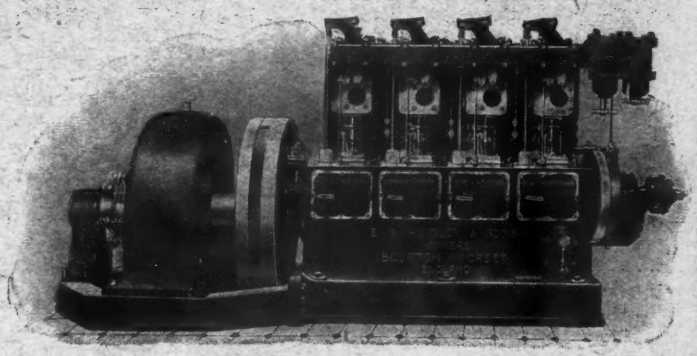

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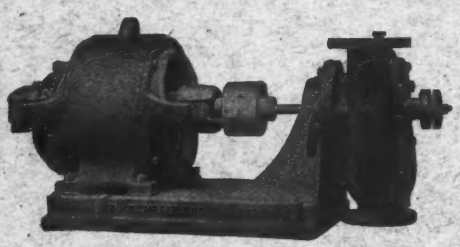

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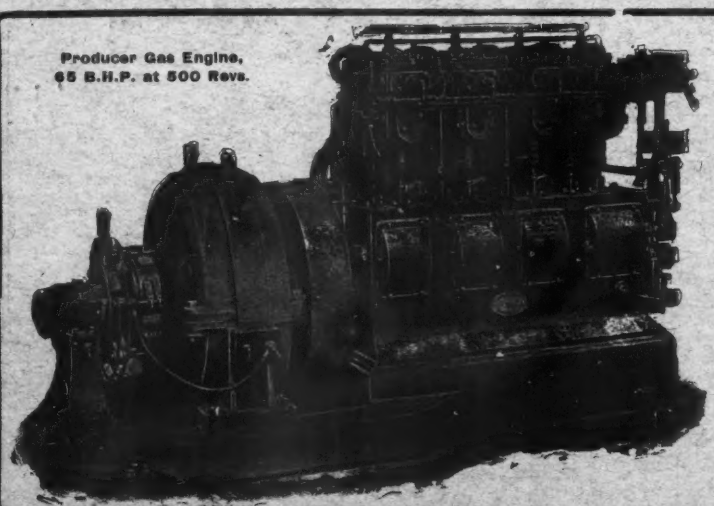

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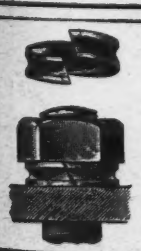

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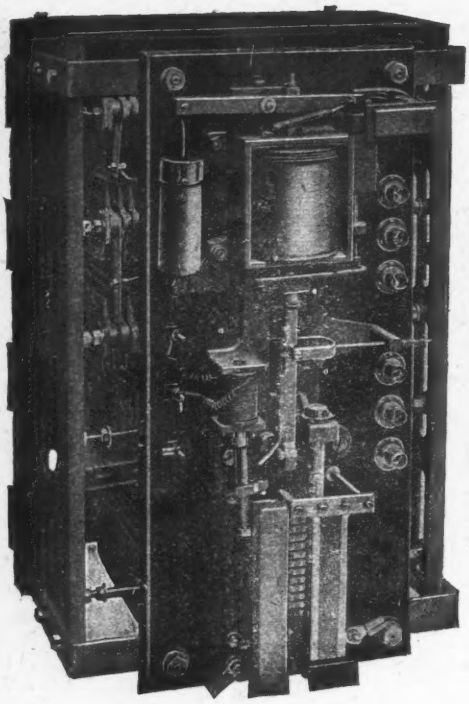

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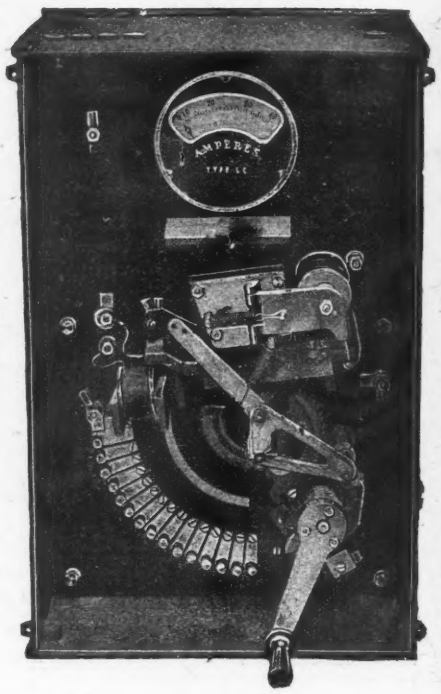

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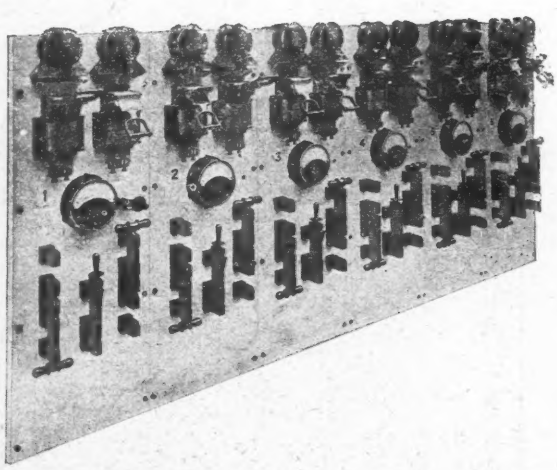

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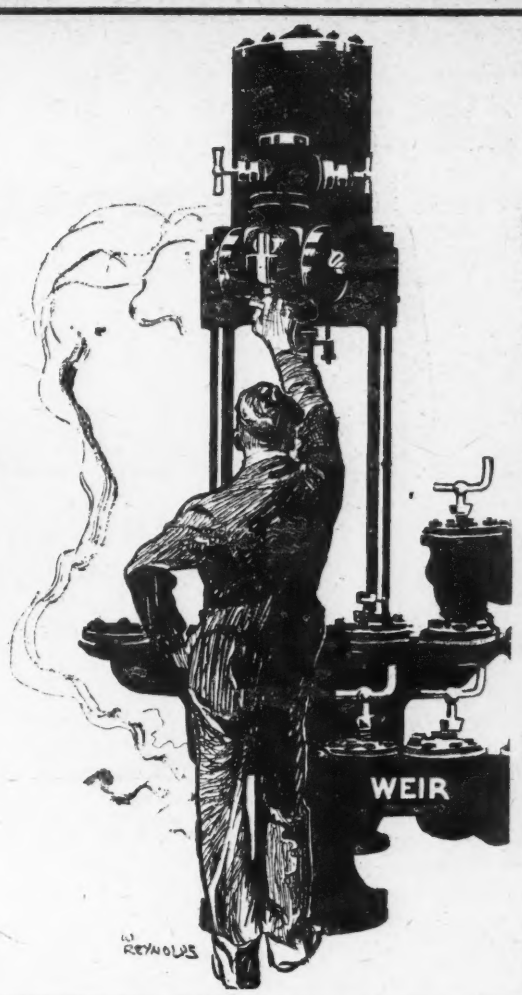

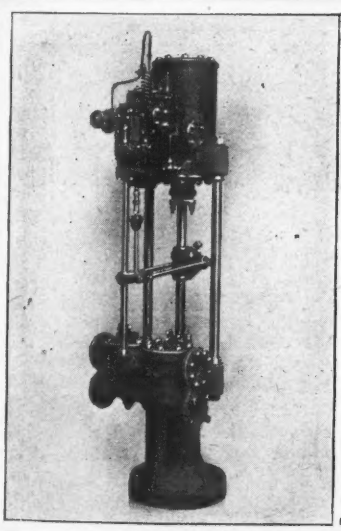

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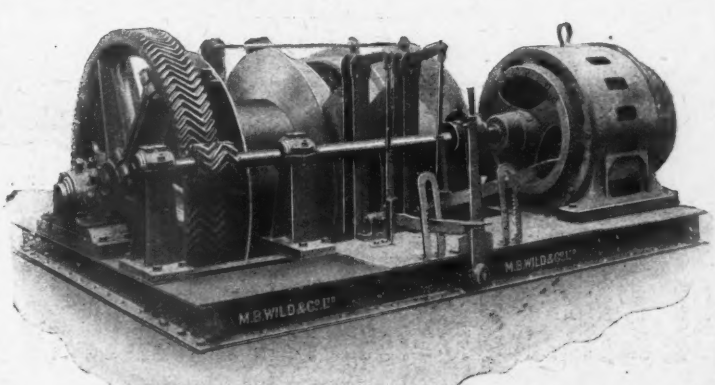

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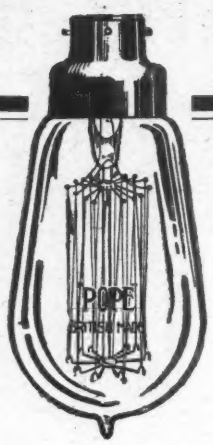

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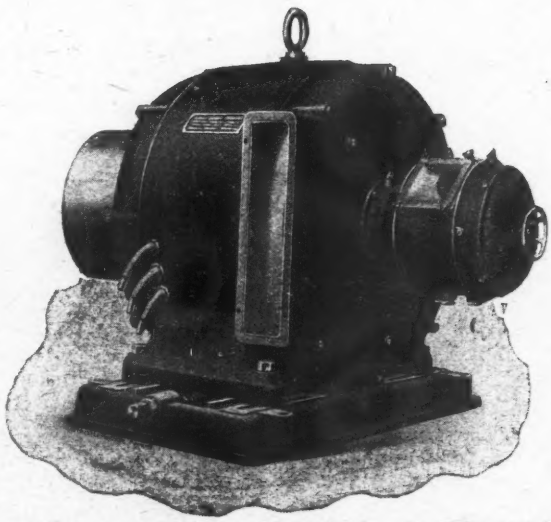

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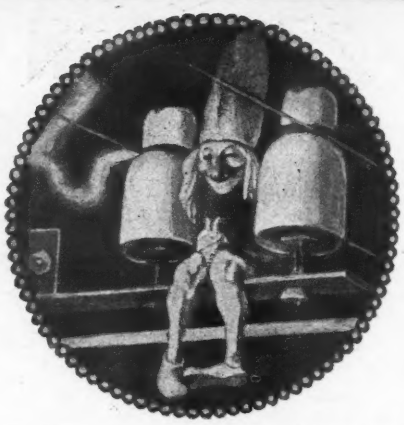

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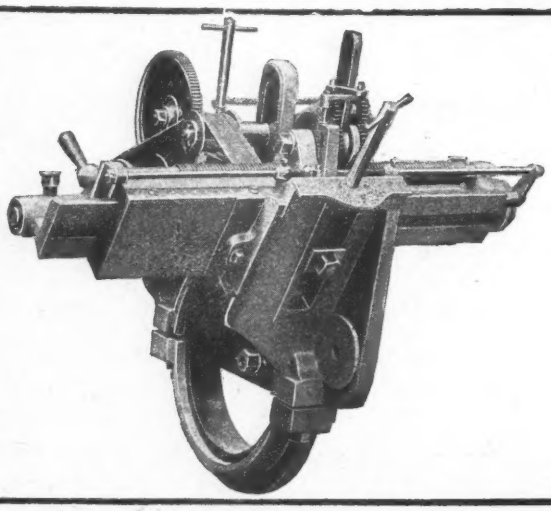

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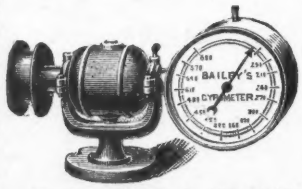

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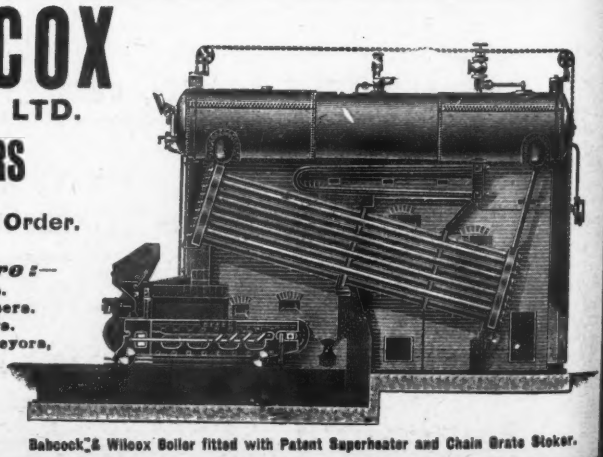

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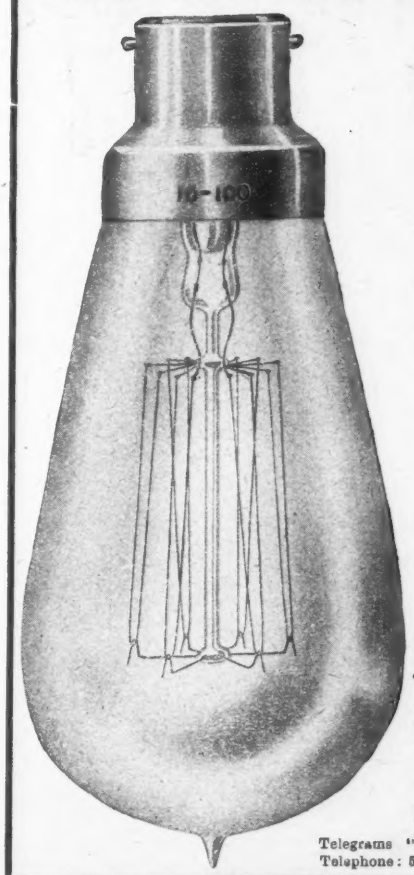

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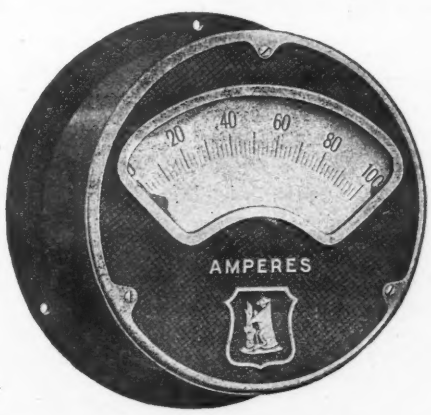

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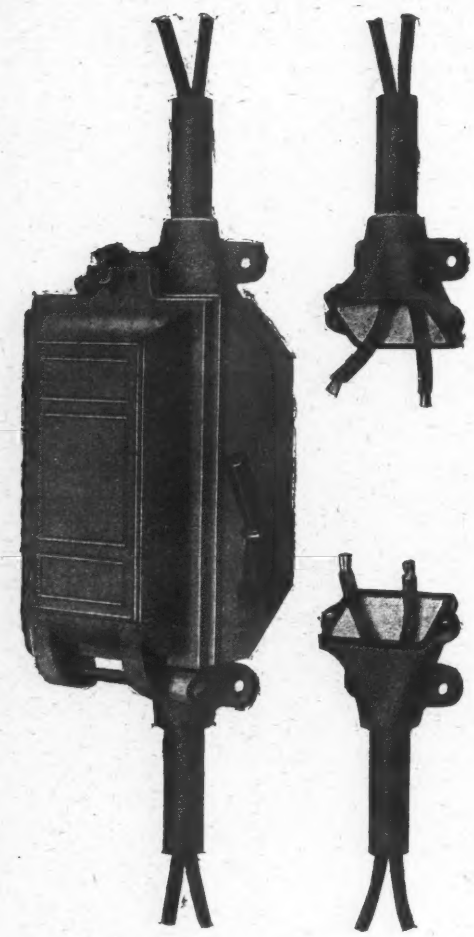

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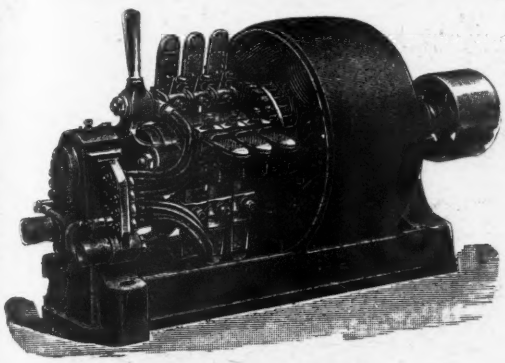

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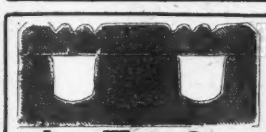

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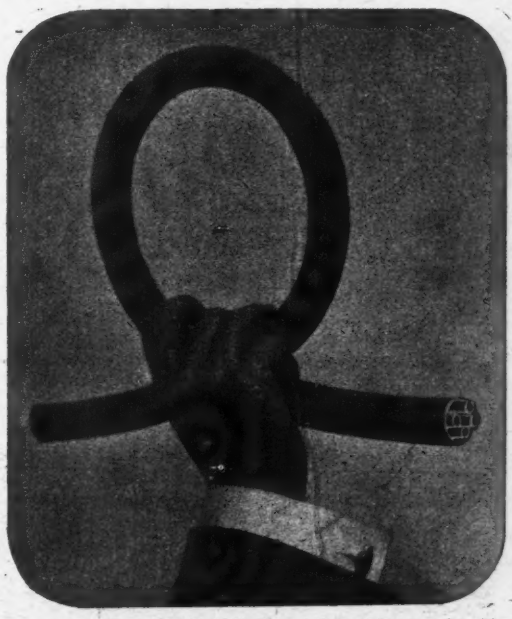

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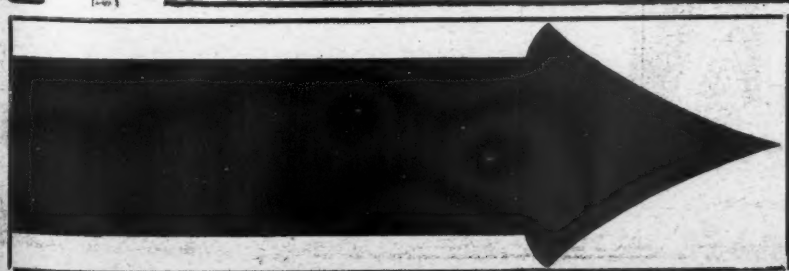

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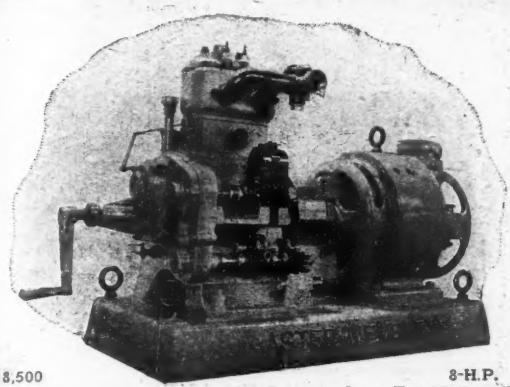

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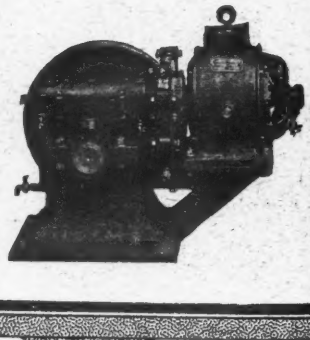

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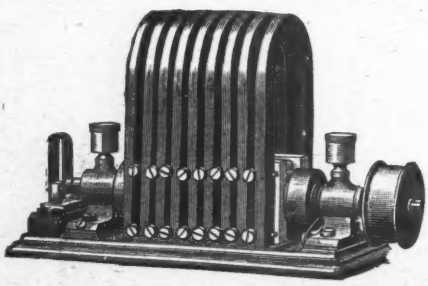

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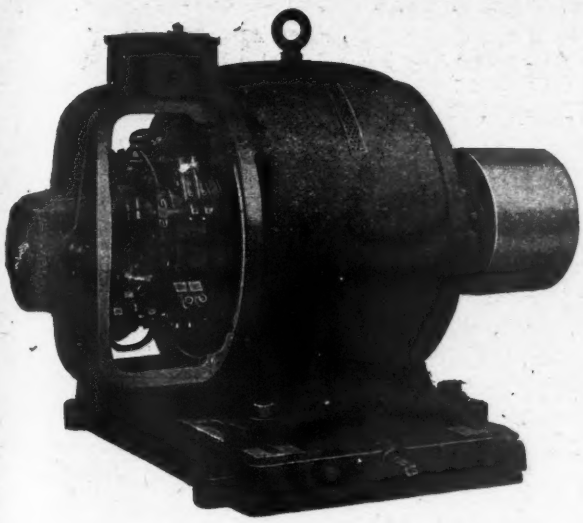

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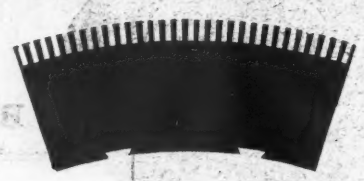

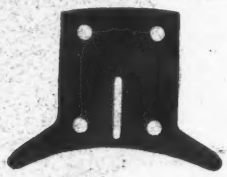

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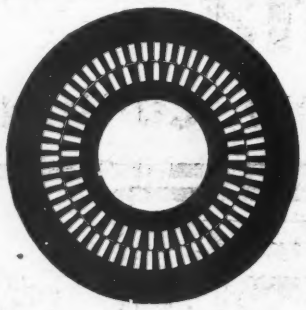

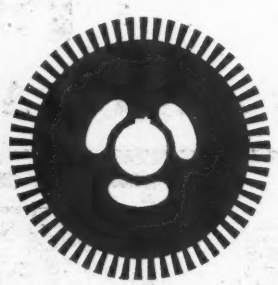

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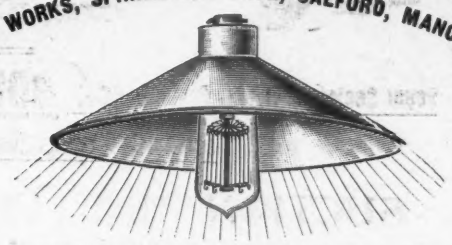

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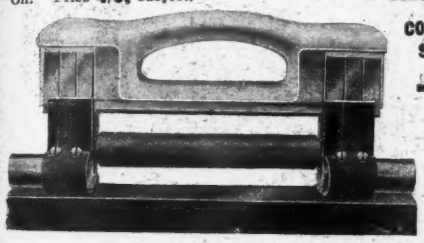

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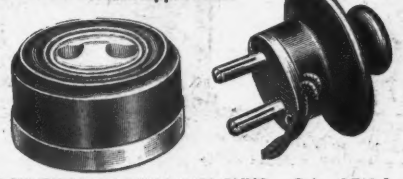

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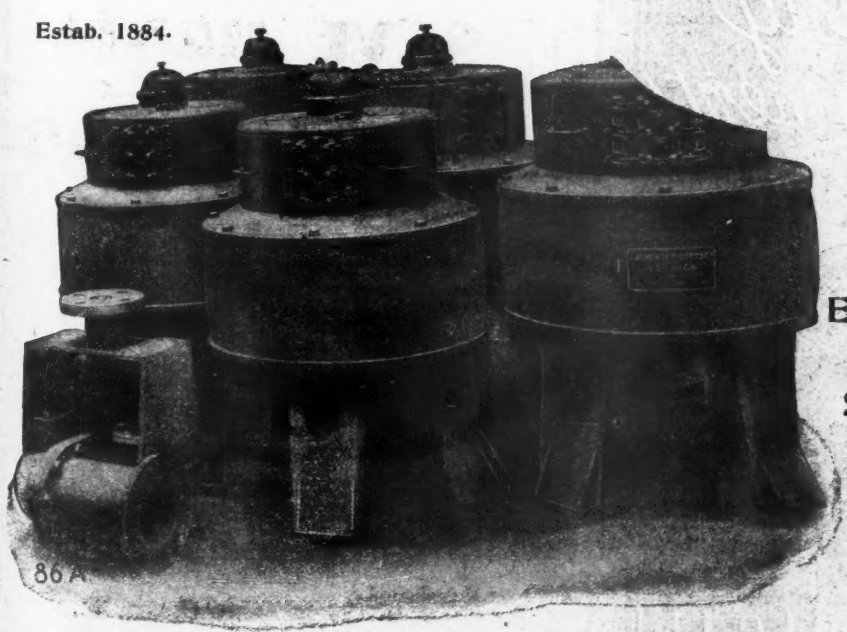

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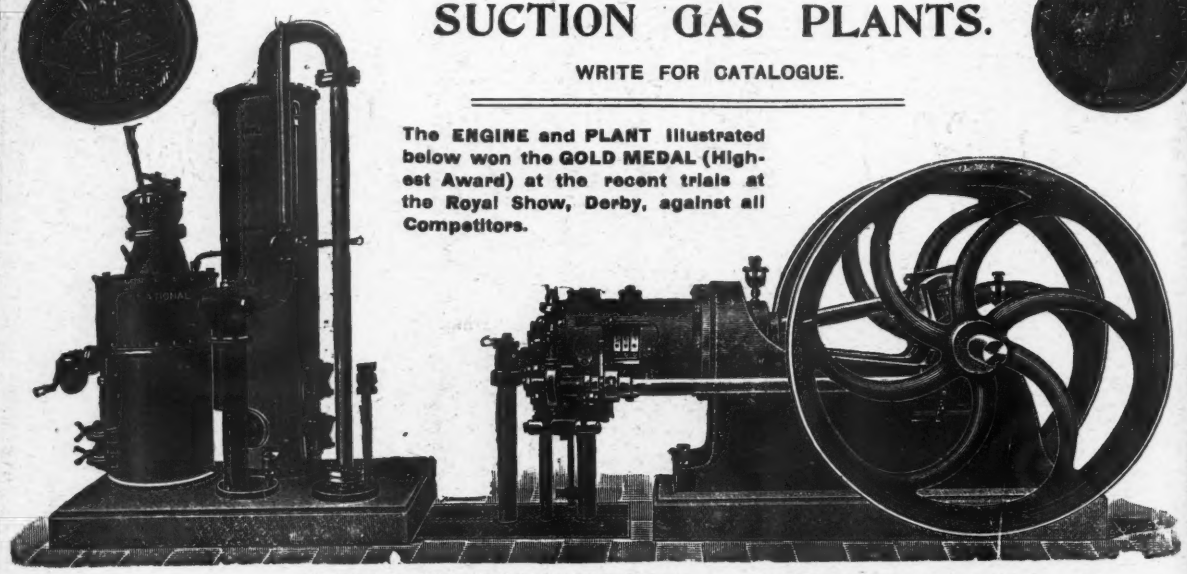

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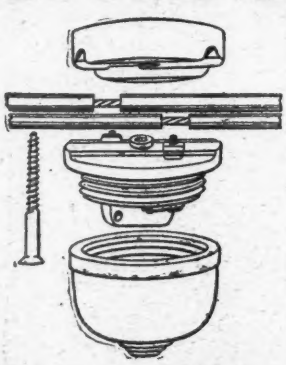

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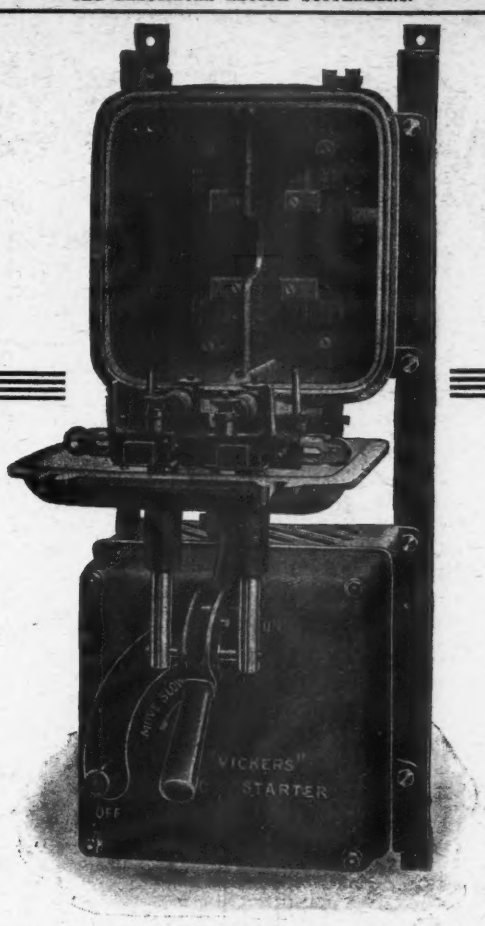

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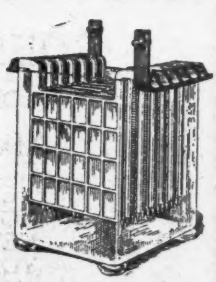

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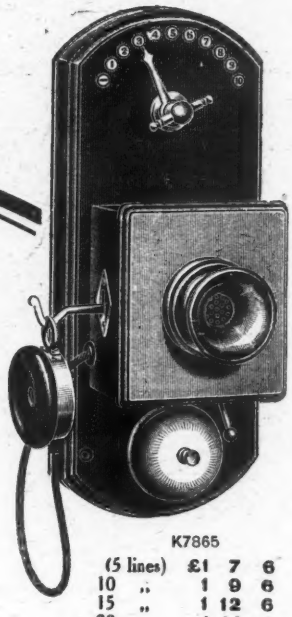

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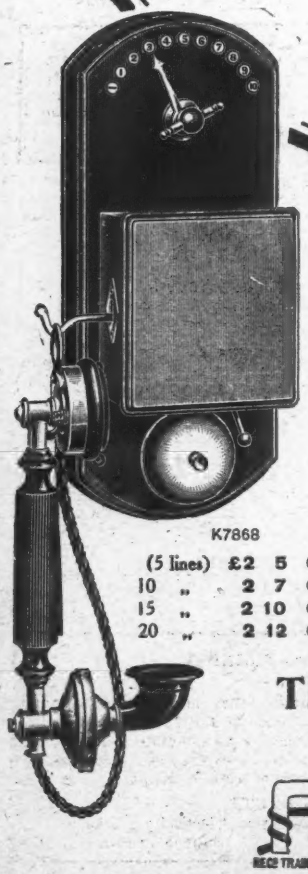

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EDUCATIONAL NOTICES.—*Continued.*

CRYSTAL Palace School of Practical Engineering. Principal, J. W. WILSON, M.I.C.E., M.I.Mech.E.—The new course will commence on WEDNESDAY, JANUARY 10th. New Students should attend at the School on previous day between 10 a.m. and 1 p.m. for examination. Prospectus forwarded on application to the REGISTRAR, School of Engineering, Crystal Palace, S.E. 6887

THE London Telegraph Training College, Ltd. (established 19 years.)—Good positions are constantly being obtained by students, after a short period of tuition, in the Wireless and Cable Telegraph Services at commencing salaries of from £100 to £200 per annum. A number of good appointments are constantly reserved exclusively for its students. Electrical knowledge not essential. The College, which owns Two Wireless Telegraph Stations (licensed by Government), holds the highest reputation among the leading telegraph companies for supplying operators and engineers. Day and Evening Classes.—Apply for Prospectus to Dept. D., Morse House, Earl's Court, London, S.W. 6839

SITUATIONS VACANT.

Latest time for receiving, 9.30 a.m. Thursday.

If letters are not to be delivered to certain firms or individuals if known), instructions to that effect should be sent to the Manager of the ELECTRICAL REVIEW, who will do his best to carry out such instructions. Letters of applicants cannot in such cases be returned to them, nor can the names of Advertisers using a number in any way be disclosed.

Original Testimonials should never be sent.

CITY OF YORK.

ELECTRICITY DEPARTMENT.

Appointment of Shift Engineer.

THE ELECTRICITY COMMITTEE of the York Corporation invite applications for the post of Shift Engineer at the York Electricity Generating Station.
Salary £91 per annum, rising to a maximum of £110 per annum. Applicants should have had experience with three-phase high-tension plant.
Applications, stating age, training and experience in central station work, accompanied by copies of not more than three recent testimonials, must reach the undersigned not later than FRIDAY, the 5th JANUARY, 1912, endorsed "Shift Engineer."

J. W. HAME,
City Electrical Engineer.

Clifford Street,
York. 6899

BARROW-IN-FURNESS.

TEMPORARY Assistant required; must be good Draughtsman, and have had recent experience in E.H.T. work; salary from £3 per week, according to experience; engagement for 6 to 12 months.
Apply, stating age, full particulars of experience, salary required, when at liberty, and enclosing copies of testimonials, to

H. R. BURNETT,
Corporation Electricity Works,
Barrow-in-Furness. 6922

(Continued on next page.)

SITUATIONS VACANT.—*Continued.*

CITY OF BRADFORD.

ELECTRICITY DEPARTMENT.

Commercial Assistant.

APPLICATIONS are invited for the post of Commercial Assistant in the Corporation Electricity Department.

Applicants, who must not be over 40 years of age, must have had a sound technical education in subjects relating to electrical and mechanical engineering, and practical training as electrical engineers, and preferably should have obtained commercial experience with a firm of electrical engineers whose business is to supply motors, arc lamps, heating, cooking, and other apparatus. Experience in connection with an electricity supply undertaking is desirable, but not absolutely necessary.

The chief duties will be to supervise all canvassing and publicity work, and the staff engaged in connection therewith; to personally interview power users and other persons with a view to securing the use of electrical energy in textile works, factories, workshops, &c., and in other ways extend the use of electricity in the City; and to carry out such other work and perform such duties as required by the City Electrical Engineer and Manager.

Canvassing is strictly prohibited.

The person appointed will be required to devote his whole time to the duties of the office, and to reside within the City.

Salary, £250 per annum.

Applications are to be made on a special form to be obtained from Mr. THOMAS ROLES, City Electrical Engineer and Manager, Town Hall, Bradford, and are to be sent, together with copies of not more than three recent testimonials, in time to reach the undersigned not later than first post on TUESDAY, 9th JANUARY, 1912, endorsed "Commercial Assistant—Electricity Department."

By order,
FREDERICK STEVENS,
Town Clerk.

Town Hall, Bradford,
December 23rd, 1911. 6898

PROVINCIAL CINEMATOGRAPH THEATRES, LIMITED.

ENGINEER'S DEPARTMENT.

APPLICATIONS are invited for the appointment of an Assistant Inspecting Engineer from persons having the whole of the undermentioned training and experience:—

(*a*) Diploma or certificate of a recognised University College for at least three years' attendance at day classes in electrical engineering.
(*b*) Two years' experience in the shops or on the test plate of an electrical engineering firm of repute.
(*c*) Two years in the capacity of switchboard attendant or charge engineer in a generating station exceeding 500 KW. capacity.

Salary to commence will be £2 per week, plus an additional allowance of third class rail and hotel expenses when travelling.

Application Forms, which are to be returned on or before the 6th prox., can be obtained on written request only from

THE CHIEF ENGINEER,
Provincial Cinematograph Theatres, Ltd.,
199, Piccadilly, W. 6934

BOROUGH OF BERMONDSEY.

THE COUNCIL of the above Borough invite applications for the position of Switchboard Attendant at a salary of 32s. per week rising at the end of one year to 35s. per week, without pension. The person appointed will be required to reside in the borough. Applicants must have had experience in a central station using the three-wire continuous-current system and in the care of a battery. Applications on forms to be obtained from the undersigned, must be sent to me endorsed "Switchboard Attendant" not later than noon on JANUARY 19th, 1912. Canvassing directly or indirectly will disqualify.

FREDK. RYALL, *Town Clerk.*

Town Hall, Bermondsey, S.E.,
28th December, 1911. 6933

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ARC Lamp Repairer wanted. Wages 8½d. per hour.—Apply, with full particulars, to BURGH ELECTRICAL ENGINEER, Helen Street, Govan. 6896

ASSISTANT wanted in test room; should be well up in transformer theory and have a good working knowledge of alternating current generally. Age 20 to 25.—Letters only, FOSTER ENGINEERING CO., LTD., Morden Road, Wimbledon. 6883

SITUATIONS VACANT.—*Continued.*

BOROUGH Electrical Engineer, large Midland Town, has vacancy for pupil. Power, lighting and traction. Premium required.—6821, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

DRAUGHTSMAN wanted, for London district; experienced in small plant lay-out.—State age, experience and salary, to 6920, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

DRAUGHTSMAN required, thoroughly experienced in switchboard switchgear designing.—Apply, stating experience, age and salary required, to "SWITCHGEAR," Veritys Limited, Aston, Birmingham. 6888

ELECTRICAL Manufacturing Company require Works Superintendent. Applicant must be of good education and technical training, strict disciplinarian, and have exceptional experience in the latest workshop practice in the economical production of large quantities of accurate repetition work. Good opening for really capable man.—Address in confidence, giving full details of age, experience and salary required, to 6900, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICAL Contractors, N.W.—Apprentices for three years, without premium; remuneration, 2s. 6d., 5s., 7s. 6d. per week each year respectively.—6859, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICAL Trades Union.—Employers requiring competent and reliable Electricians, Wiremen and Armature Winders, can obtain them for any district by applying to the GENERAL SECRETARY, 26, Cannon Street, Manchester. London District only, 41, Cowcross Street, E.C. Competent workmen are invited to apply for full particulars of Union to the same addresses. 6366

EXPERIMENTAL Laboratory.—Junior Assistant wanted, with some experience in testing; Manchester district.—Apply, giving full particulars and salary, to 6881, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

FITTER-Driver; wages 5s. per day. Permanent. Only those able to undertake the running and repair of Belliss engines need apply, stating age and experience and enclosing copies of testimonials, to GENERAL MANAGER AND ENGINEER, Manx Electric Railways, Douglas, I.O.M. 6889

FOREMAN wanted, for the motor and dynamo assembly department, by an electrical manufacturing firm in the Manchester district.—State age and salary required, 6884, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

GLASS-Blowers, thoroughly experienced, wanted; used to metallic filament and carbon lamp work.—State experience, references and wages required, 6871, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

GOOD Wireman wanted, used to City work; only those disengaged and in London district need apply.—T. GUNN, LTD., 34, Fore Street, E.C. 6903

IMPROVER wanted, with technical and shop training, to attend switchboard and assist in works superintendent's office. Commencing salary 20s. per week.—Reply, stating age, and giving full particulars of training and experience, to H. R. BURNETT, Corporation Electricity Works, Barrow-in-Furness. 6784

IMPROVER wanted, in D.C. three-wire L.T. central station in S.W. London district. Must have had theoretical and mechanical training. Wages 10s. per week, rising to 13s.—Apply, stating age and particulars of training, to 6785, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

JOINTERS for Paper, Lead-Covered and Armoured Cables required. Must do own plumbing.—Apply FOOTE & MILNE, LTD., 66, Victoria Street, S.W. 6760

METER and Arc Lamp Attendant required, must have good technical knowledge, smart appearance and manner, also a knowledge of alternating current meters; wages 30s. per week.—6926, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

PROGRESS Clerk or young Engineer, used to following orders and details in shop, also used to handling shop papers and correspondence. Previous experience with switchgear preferred. Near London.—State fully experience, age, salary, 6927, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

PUPIL.—Vacancy in Consulting Engineer's Office. Premium 50 guineas for six months with possibility of partnership.—6868, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

(*Continued on next page.*)

SITUATIONS VACANT.—*Continued.*

REPRESENTATIVE required, for large wholesale electrical house, London district. Preference will be given to gentlemen with experience in lamps and wiring supplies, and in export business. —Apply, stating full particulars, qualifications, &c., and salary required, to 6882, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

REQUIRED at once, Clerk; must have had good experience of prime cost work and electric supply or wiring contractors' accounts.—Apply, stating experience, age, &c., and salary required, to THE SECRETARY, Electricity Supply Company, Limited, Guildford, Surrey. 6928

REQUIRED, two thoroughly reliable men of good address, to represent illumination firm. Engineer trained and knowledge of lighting installations preferred.—State full career and salary required, 6828, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ROTARY Converter Sub-station Attendant required, at commencing rate of 24s. weekly, South Coast.—State particulars of previous experience, age and when free, 6931, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

SEVERAL good Wiremen wanted by Contractor in Provinces, near London. Rate, particulars, &c.—6925, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

SHIFT Electrician, for A.C. and D.C. plant in large up-to-date works in Liverpool; annual output of over three millions B.O.T. units. Must have workshop training and useful technical knowledge; experience of reciprocating and steam turbo sets preferred. State age, qualifications and wages expected.—Apply E 53, Birchall's Advertising Offices, Liverpool. 6890

STORAGE Battery Company require competent man as Inspector and Outside Foreman.—Give full particulars of experience, age, references and salary required, 6897, ELECTRICAL REVIEW, 4, 4, Ludgate Hill, London.

SWITCHMEN wanted immediately for a London station. Experienced man required, capable of handling direct and alternating current boards. — Apply, giving particulars of experience, when disengaged, age, &c., to 6902, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

TRAVELLERS, energetic and pushing, required by important City house, for selling well-known electric filament lamps. Good connections with big buyers absolutely essential. Salary and commission for suitable men.—Send testimonials and full details to 6935, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

TWO Juniors required, for large traction system in London, for power station and sub-station polyphase plant. Applicants must have sound technical knowledge, and have served a course through the works in electrical and mechanical engineering. Excellent opening and quick promotion for reliable and efficient engineers.—6893, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WINDING Charge Hand wanted, by manufacturers of dynamos and motors in Manchester district. Must have had previous experience as charge hand.—State age and salary required, 6886, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED.—Meter Inspector for small D.C. central stations, must be used to and be able to test and fix and repair Ferranti and C. & H. meters. Wages £1 per week to commence.—Apply, stating experience, to 6892, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED, first-class Working Electrician to take charge of motors and generators in London works.—Reply, stating age, experience and salary required, to 6879, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED, Engineer experienced in designing and manufacturing power switchboards for telephone exchanges. Must be able to arrange circuits and be conversant in all power work appertaining to telephone exchanges.—State age, experience and wages required, also reference, to B. I. and H. Cables, Milton Road, Edge Lane, Liverpool. 6891

WANTED, two Assistant Telephone Engineers, must be well versed in C.B. circuits and apparatus and able to prepare wiring diagrams and specifications.—State age, experience and wages required, also reference, to B. I. & H. Cables, Milton Road, Edge Lane, Liverpool. 6895

WANTED, an experienced Draughtsman, must be accustomed to the design of press tools as used in the manufacture of electrical machinery, and able to lay out formers for winding armature and stator coils, &c.—Apply, stating age, experience, and salary required, to SIEMENS BROS. DYNAMO WORKS, LTD., Stafford. 6921

SITUATIONS VACANT.—*Continued.*

WANTED, an experienced Tramway Overhead Linesman. Must have good knowledge of armature winding.—Apply by letter, stating age, experience, &c., to WORKS SUPERINTENDENT, Tramways Depôt, Ley Street, Ilford, Essex. 6936

WANTED, Draughtsman for electric lift work. State age, salary and experience.—Reply 6937, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED, smart, steady Young Man (single) to take charge of a private electric light plant, must be a good electrician and thoroughly understand gas engines and suction gas; live in.—State age, references, wages required and when disengaged, MANAGER, Union Hotel, Penzance. 6915

WANTED, Wireman with traction experience for electric railway, London. Age not over 35 years. Wages 34s.—6829, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED, one Sub-station Attendant and one Switchboard Attendant, for 8000 KW. station.—Apply, stating age, experience and salary required, to 6854, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WINDING Foreman wanted, by manufacturers of dynamos and motors in Manchester district. Must have had previous experience as foreman.—State age and salary required, 6885, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WIREMAN-Fitter wanted, for small motor installations. Knowledge of plumbing would be useful.—State age, rate and experience, to 6919, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

YOUNG Engineer wanted, of good address, used to erection of arc lamps, smart at locating faults on outside job.—6901, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

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APPOINTMENTS FILLED.

APPLICANTS for Switchboard Attendant vacancy at Southend-on-Sea Electricity Works are thanked, and informed that it has now been filled. 6894

SITUATIONS WANTED.

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A COMPETENT Foreman Electrical Mechanic desires change. Electro-deposition, plant erection, assembly with unskilled labour.—52, Montpelier Gardens, East Ham. 6735

ELECTRICAL Engineer (35), experienced erection and maintenance, lighting, power plant (suction gas, steam, oil), three-phase D.C. battery, telephones, pumps and large units, seeks appointment, charge estate or works. Married, no incumbrance. Five years present sit. Testimonials.—6737, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICAL Engineer, single (32), seeks berth; practical knowledge, steam, gas and oil, erections, cable laying, wiring telephones, &c.; energetic and of good address.—6918, ELECTRICAL REVIEW 4, Ludgate Hill, London.

(Continued on next page.)

SITUATIONS WANTED.—*Continued.*

ELECTRICAL and Mechanical Engineer (25) seeks appointment with responsible firm in or near London on commercial or mechanical side. Three years' technical, seven years' practical experience.—6932, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICIAN, wiring and plant; wide experience.—C. H., 10, Egbert Street, Primrose Hill, N.W. 6913

ELECTRICIAN, 12 years' experience lighting, bells, power, &c.; excellent references.—W. R., 18, Mornington Road, New Cross, London. 6906

ELECTRICIAN-Wireman, lighting, motors, telephones. — 15, Westfield Road, Croydon. 6911

ENGINEER (30) seeks situation; good contractor's man; schemes, estimates, designs, erection or running of plant (steam, gas, oil).—6909, ELECTRICAL REVIEW, 4. Ludgate Hill, London.

WIREMAN, good all-round.—W. B., 243, Seward Street, Goswell Road, E.C. 6929

WIREMAN wants job, casing or screwed tubing.— D., 265, Beresford Street, Walworth. 6914

WIREMAN wants job; lighting, power, &c.—G. S., 249, Liverpool Buildings, Liverpool Road, N. 6905

WIREMAN (25) desires situation; 8½ years' experience; also mate, if required.—SHOTTER, 4, Byrne Road, Balham. 6907

WIREMAN, disengaged; all systems: good references.—ELECTRICIAN, 194, Sheringham Avenue, Manor Park. 6908

WIREMAN, or Wireman's Mate, seeks situation. Young; good references,—PITMAN, 7, Market Street, Stepney. 6930

YOUNG Electrical Engineer (25) desires change; workshop, A.C. and D.C. plant maintenance, all repairs, winding, &c.—6910, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

23½, trained London University Technical College, 3½ years', experience modern E.H.T. generating station and converter sub-station, switchboard attendant in charge; situation required anywhere.—6917, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

PARTNERSHIPS.

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CHIEF Electrical Engineer open for engagement, where up to £500 and his services could be profitably employed.—WYATT, 49, Oriel Road, Bootle. 6766

WANTED, for established provincial manufacturing and factoring business, Partner. Must be practical and very energetic; good opportunity for right man; one having connection preferred. Accounts audited. — Apply, 6802, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

£450.—Active Partner required to invest this sum in joining advertiser, manufacturing electrical speciality, universally used and easily sold; plant and equipment already installed.—6916, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

AGENCIES.

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ELECTRICAL Engineer, well established, about to open showrooms, &c., in main thoroughfare, Leeds, is desirous of representing good firm, or would entertain an offer to make same a depôt for good electrical speciality.—6730, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

FOR SALE.

FOR SALE.

24 VARIOUS Capstan and Brass Finishers' Lathes, including:—
Two 2-in. × 24-in. Flat Capstan Lathes (by Jones and Lamson); Automatic Capstan Lathe (by Potter & Johnson), 12-in. centres; Double Geared Universal Brass Finisher's Lathe (by Davis & Egan), 7½-in. centres, 6-ft. bed.
18 Various Planing Machines, including:—
Modern High-speed Planing Machine, to plane 9 ft. × 3 ft. × 2 ft. 6 in., with two Tool Boxes.
Rack-driven Planing Machine, to plane 15 ft. × 5 ft. 4 ft. 6 in., with three Tool Boxes.
22 Various Radial Drilling Machines, including:—
New 3-ft. Radius Radial Sensitive Drilling Machine, constant drive.

CATALOGUE of Stock MACHINERY. 2-3,000 LOTS, free on application. Inspection invited.

THOS. W. WARD, LTD., ALBION WORKS,
Tel.: "Forward, Sheffield." SHEFFIELD.

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ACCESSORIES.—Proprietor of Patents for Tumbler Switches, Fuses, Dimming Switches, is open to negotiate for sale right out, or manufacture under licence.—6763, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

C. JENNINGS & CO. can supply Woodwork of any description at short notice, Stairs, Balusters, Newels, Handrails, Sash Bars, Mouldings and Joinery. Support British industry and refuse foreign doors. We compete. General woodworkers.—991, Pennywell Road, Bristol. 3315

DYNAMO by Electric Construction Co., 400 amperes, 110 v., 550 r.p.m., compound-wound, cheap. — MARTIN, 320, Witton Road, Birmingham. 6740

DYNAMOS, 3000, 1500, 1000 and 750 amperes, at 6 volts ready for delivery; also smaller sizes delivered from stock. Machines let out on hire.—CANNING & CO., Electro-Platers' Engineers, Birmingham.

FOR Sale, 500-KW., 500-volt D.C. Generating Set, Peache Engine, E.C.C. Dynamo. Low price for prompt sale. — ENGINEER, Electricity Works, Wolverhampton. 6037

FOR Sale, two 150-KW. compound belt-driven Generators, 400 volts, speed 450 revs., modern, new condition, or as motors about 200 B.H.P.—WINDER, Cross Belgrave Street, Leeds. 6732

FOR Sale, 60 new Standard size Royal Ediswan Radiator Lamps, B.C. 100 and 110 volts; also 159 200-v. 32-C.P. B.C. new Royal Ediswan Carbon Lamps. Low offer for either lot would be entertained.—6770, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

FOR Sale, one 30-in. Foot Guillotine; one 3-in. Screw Fly Press, French type, 15½ in. clearance; one 1¾-in. ditto, 9 in. clearance; one flat Photo Printing Frame 4 ft. 6 in. × 3 ft. One Singer Work Room Sewing Machine. These are in first-class condition, and can be viewed by appointment at "GRAPH," 5, Tottenham Street, London, W. 6776

FOR Sale.—New Generating Set, direct-coupled on iron bed, as follows:—Motor, three-phase, 205 volts, amps. 42, periodicity 50; generator 65 volts × 67 amps. direct. Price complete with starters, £35; can be seen.—RUFFELL'S IMPERIAL BIOSCOPE, LTD., 12, Little Newport Street, London, W.C. 6729

FOR Sale or Hire, high-class Dynamos, Motors, Alternators, Cable and Arc Lamps.—PERCY HUDDLESTON & CO., 72, Finsbury Pavement, E.C. 6507

MOTOR-Generator (E.C.C.) 500 KW., 60 cycles, 2400 volts, alternating to 220 volts D.C., 500 R.P.M. Condition as new; special price for quick sale.—BELLISS & MORCOM, LTD., Ledsam Street, Birmingham. 6860

TWO Bergmann 34-kilowatt Dynamos, 205 v., 790 r.p.m., 4-pole compound-wound; low price.—MARTIN, 320, Witton Road, Birmingham. 6861

60-KW. Direct-coupled Lighting Set, 240 volts, 6-pole type, 250 amps., Allen compound engine. 40-B.H.P. Motor, by British Westinghouse, almost new, 4-pole type, 440 volts, with starter and switch. 36-B.H.P. Motor, ditto, ditto. 250-I.H.P. and 120-I.H.P. "Browett" Inverted Compound Engines. — THOS. MITCHELL & SONS, LTD., Bolton. 6807

(Continued on next page.)

BUSINESSES FOR SALE AND WANTED.

A WELL-established high-class Electrical Engineer's and Contractor's Business in full working order for Sale as a going concern. Central position in Manchester, well equipped, good prospects.—Apply, 6924, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

£185.—First-class Electrical Contractor's Business.—Full particulars, apply 6912, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ARTICLES WANTED.

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ACCUMULATORS, Second-hand, any type, wanted; also Dynamos and Machinery, Lead Peroxide, Old Copper Cable, Scrap Metals, and every description of Metallic Dross purchased for cash, town or country.—Write A. BROWN & SONS, 142, Lower Clapton Road, N.E. Telephone: Dalston 555. 4228

OLD Electric Lamp Tops, Cable and Wire bought for cash.—SMITH & Co., 2, Ranelagh Road, East Ham, London, E.

PLATINUM, in any form and quantity, purchased at highest prices by DERBY & Co., LTD., 44, Clerkenwell Road, London.

WANTED, Generating Sets, all sizes, Boilers, Accumulators, Dynamos, &c., for export; also Scrap Cable and Metals. Complete plants purchased.—WILLIAMS & SONS, 73, Queen Victoria Street, London. Telephone, 3938 London Wall. 1481

WANTED, cheap Plant, in perfect condition, 460 V., D.C., 50-KW. Generator, 50-H.P. Motor, 10-H.P. Motor.—HARRY MOSS, Horton Grange Road, Bradford. 6762

WANTED, Old Electric Lamp Tops, Scrap, Platinum, Mercury, False Teeth, Copper, Cable, Metals, Waste, Rubber, &c.—TAYLOR, 100A, Blackstock Road, Finsbury Park, N. 6904

WORKSHOPS, PREMISES AND SITES TO LET OR WANTED.

FARNHAM, SURREY.

Town and Country Districts just being Electrically Lighted.

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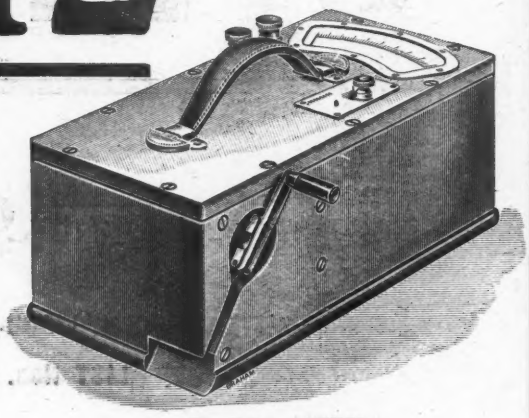

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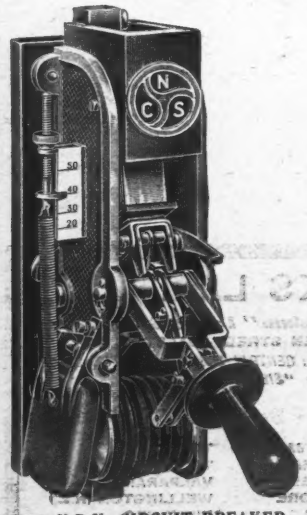

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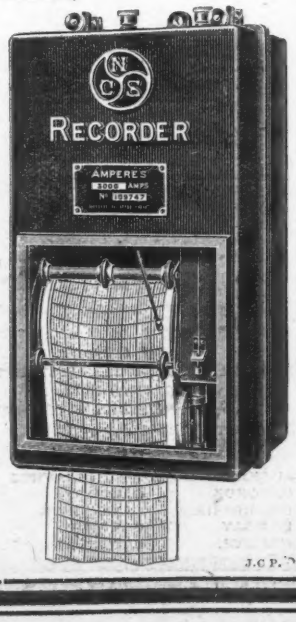

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REMOVAL.

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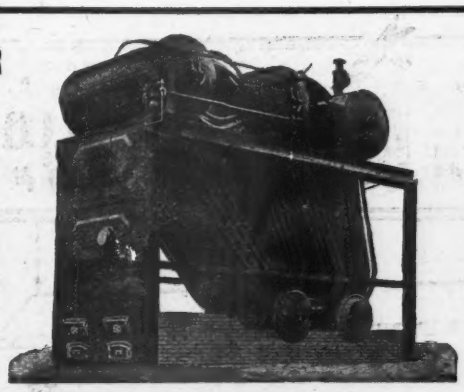

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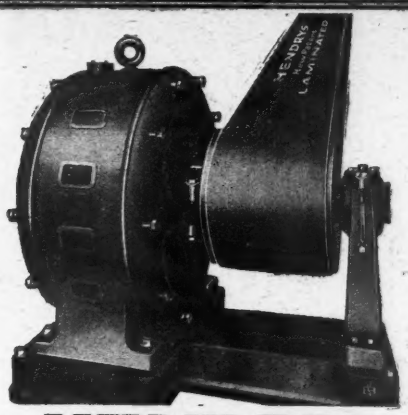

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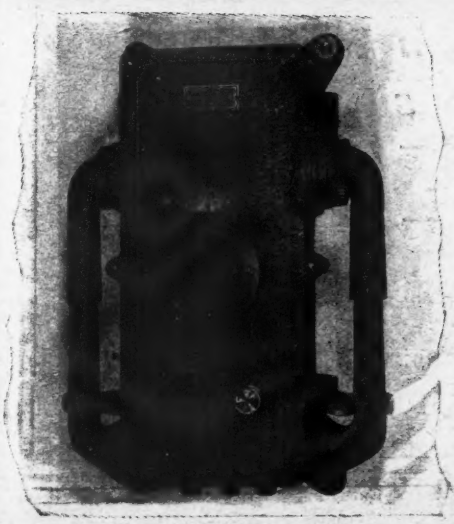

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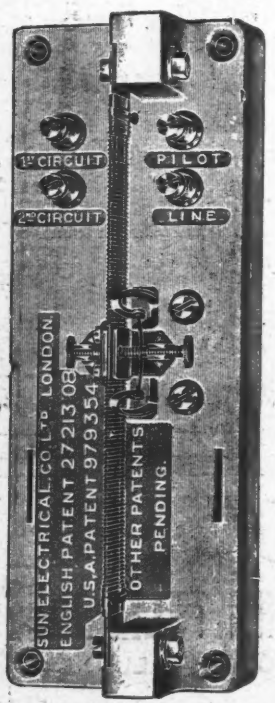

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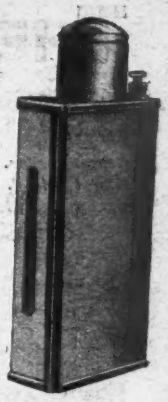

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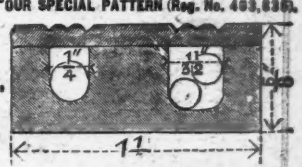

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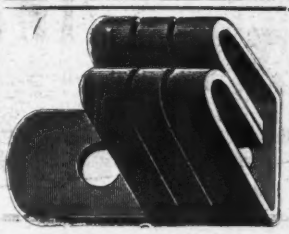

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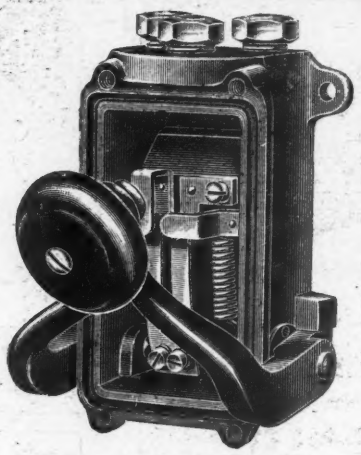

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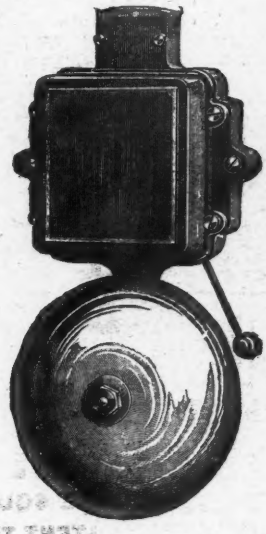

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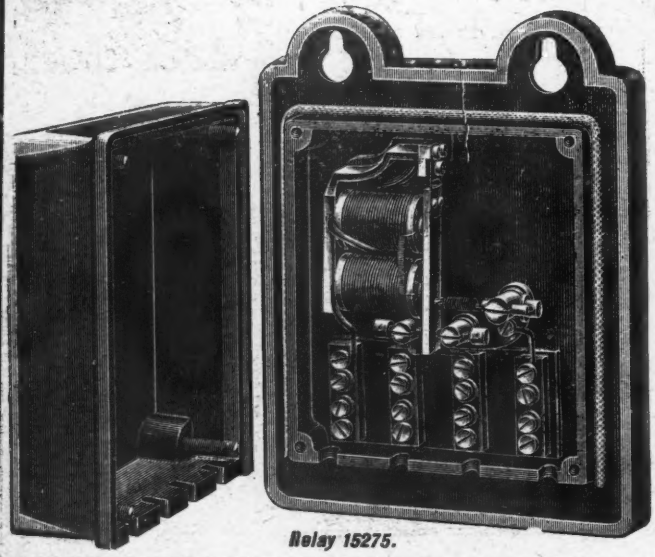

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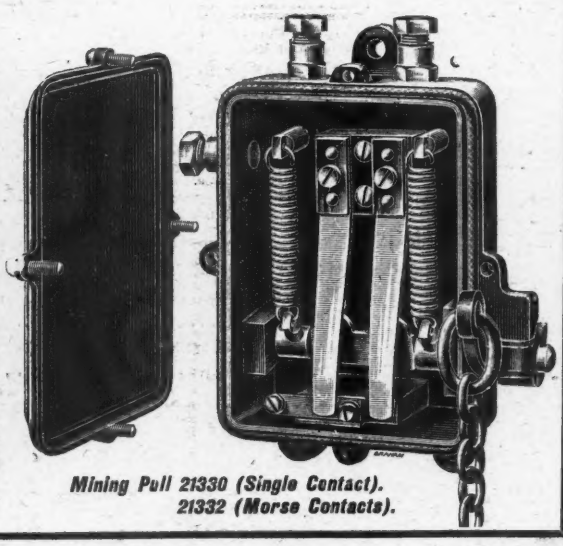

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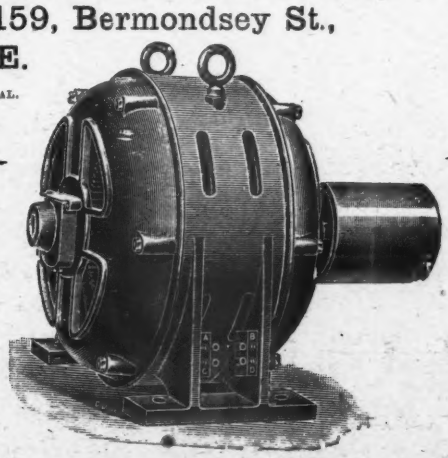

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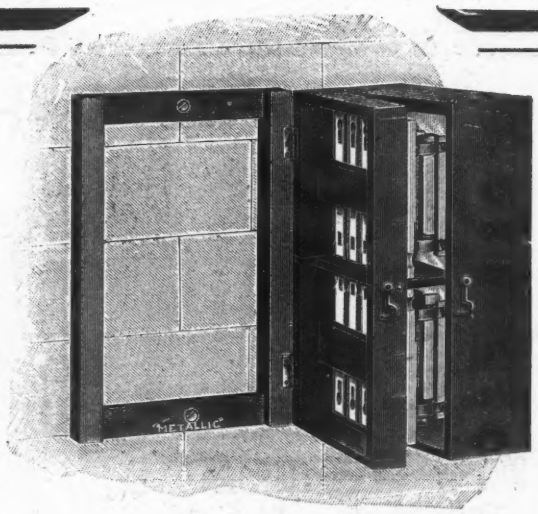

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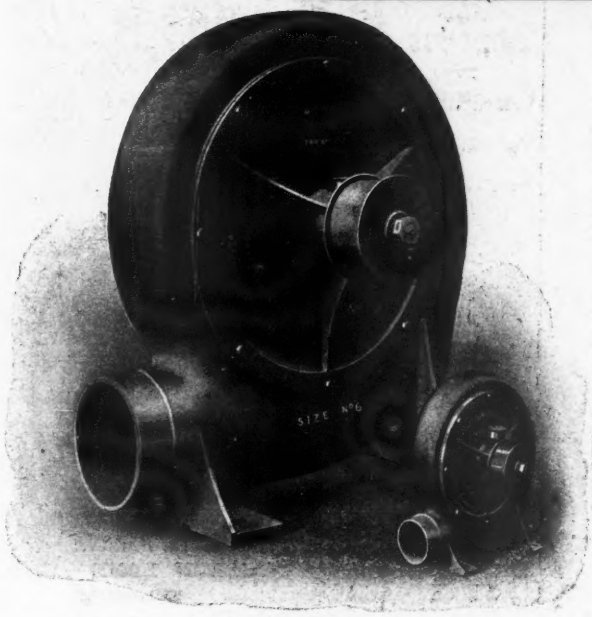

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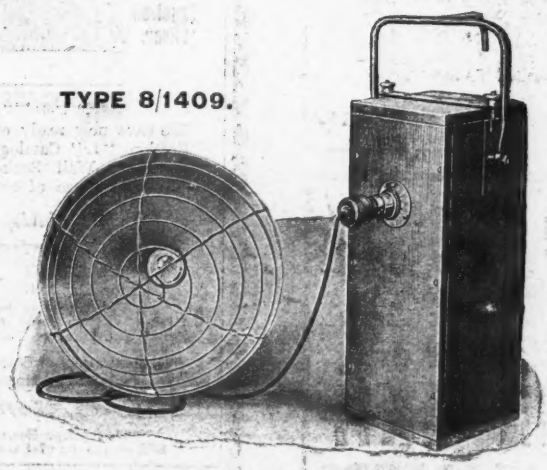

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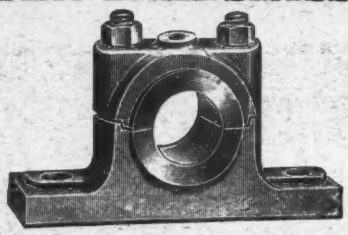

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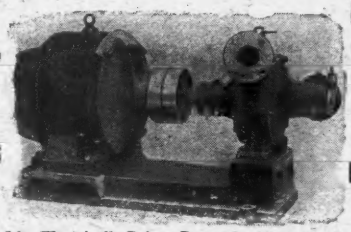

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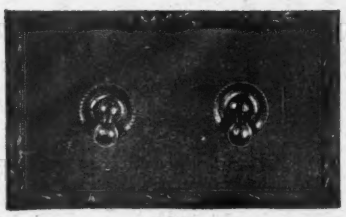

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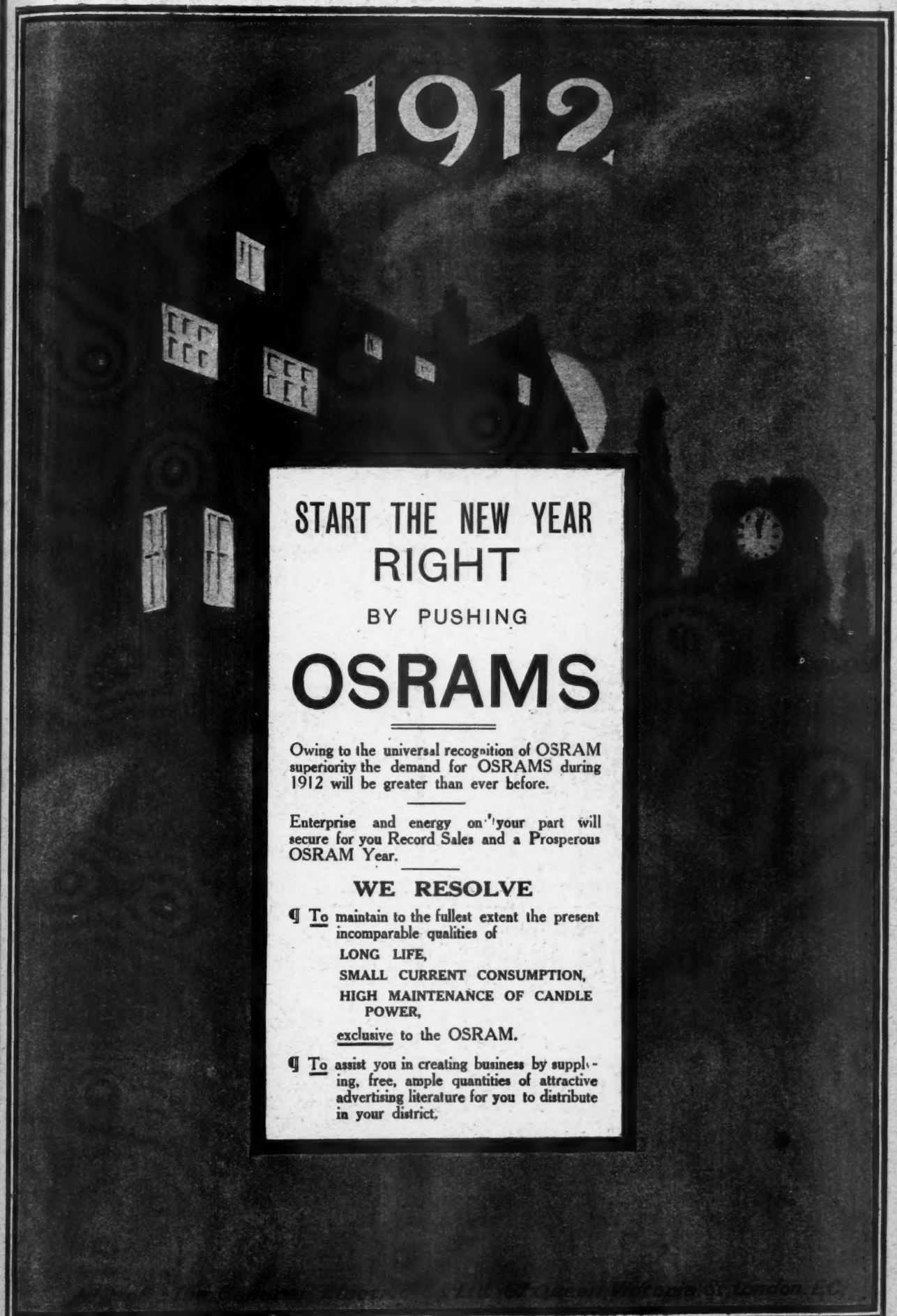

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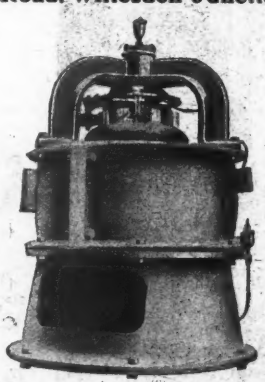

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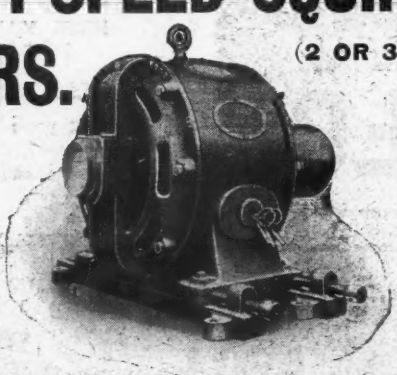

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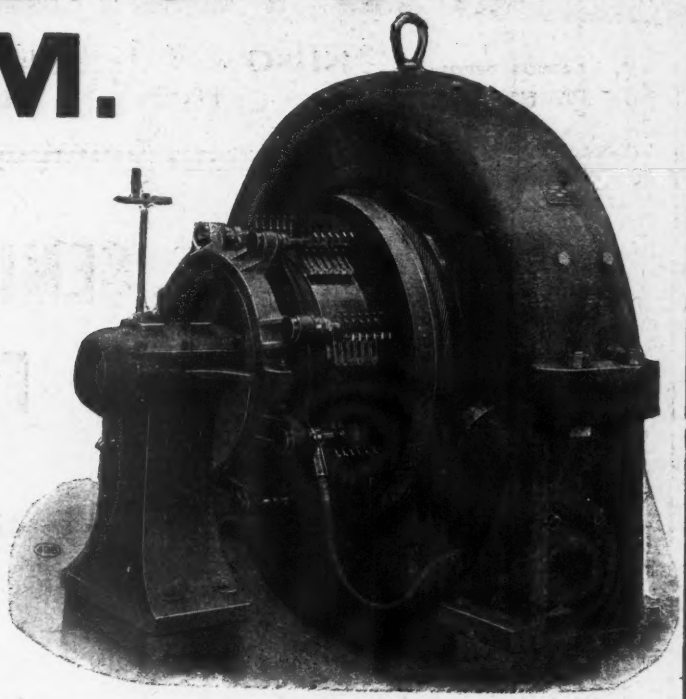

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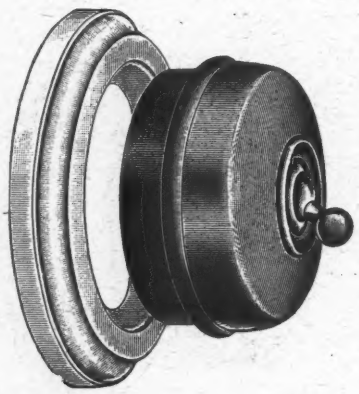

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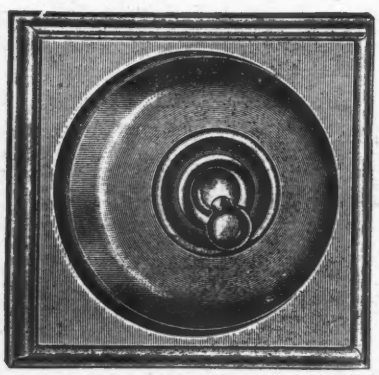

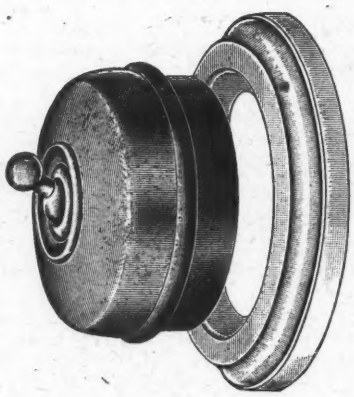

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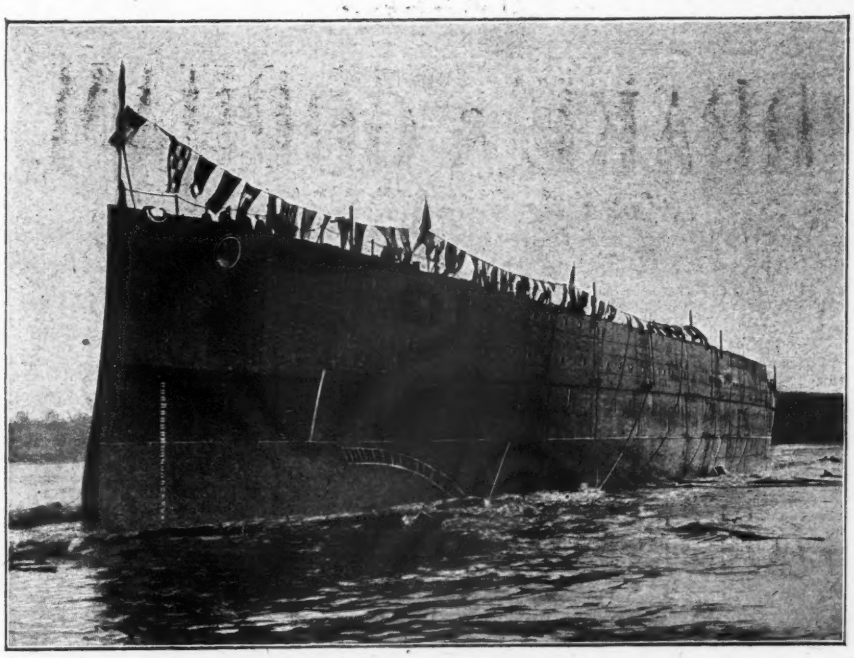

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CONTRACTORS' COLUMN.

[The following information is published in the interests of electrical contractors and others who are seeking for openings for new business. Considerable expense is incurred in the production of this column, and every care is taken to ensure that the information is new and accurate, but it will be understood that in a matter where so many correspondents are engaged, and where the amount of information to be handled is very large, this cannot always be guaranteed. If alleged inaccuracies are reported to the Editors, they will be fully investigated.]

ABERTILLERY.—Extensive waterworks scheme for the Abertillery and District Water Board; B. Lathem, engineer, Westminster.

ADDINGHAM (near SKIPTON).—Proposed Primitive Methodist Chapel; Trustees.

ALLOA.—Extensions for J. Paton & Sons, yarn manufacturers, Alloa.

ASHTON-UNDER-LYNE.—Proposed premises for accommodation of refuse plant; Borough Surveyor.

BARMBOROUGH (near DONCASTER).—Proposed Primitive Methodist Church; Trustees.

BARNSLEY.—Proposed additions at the Old Town School; Secretary, Education Committee.

BELFAST.—Motor works for V. H. Robb & Co., Chichester Street.

BENTLEY (near DONCASTER).—Contemplated Primitive Methodist Church.

BEXHILL.—Three detached houses, Cooden Sea Road, and three bungalows, Cooden Drive; Tubbs & Messer, architects, Woking. Detached house, Penland Road; Piggott & Oxley, architects, Hastings. Detached house, Manor Road; J. H. Lye, architect, Station Road, Bexhill. Addition to "Haslingfield," Penland Road; J. B. Wall, architect, Devonshire Road, Bexhill. Pair of semi-detached houses, Arthur Road; G. E. Maynard, architect, Collington Avenue, Bexhill.

BIRMINGHAM.—Improvements at New Street Station, with electric lighting (£100,000); Secretary, L. & N.-W. Railway Co.

BOLTON.—Contemplated extensions at the Church Institute; Rev. J. E. Kent, Principal.

CARCROFT (near DONCASTER).—Proposed Primitive Methodist Church; Trustees.

CARMARTHEN.—Electric theatre, for L. Vint, theatre proprietor, Neath and Llanelly.

CHAPEL-EN-LE-FRITH.—Waterworks scheme at Dove Holes; Clerk to U.D.C.

CLAYTON (near BARNSLEY).—Proposed new Wesleyan Church at Clayton West; Rev. W. H. Lowry, superintendent, Denby Dale Wesleyan Circuit.

CONISBOROUGH.—Contemplated additional hospital accommodation; Clerk to the Mexbro' and Doncaster Joint Hospital Board.

COVENTRY.—Elementary school, Centaur Road (1,148 children); F. Foster, architect, Masonic Buildings, Coventry.

CROYDON.—Motor garage, stores and offices, Selhurst Road, South Norwood; D. Kennedy, Pembury Road, South Norwood. Disinfecting works and one house, Factory Lane; Borough Surveyor.

CUPAR (FIFE).—Proposed alterations and additions to Monimail U.F. Church; Clerk, Cupar U.F. Presbytery.

DARLINGTON.—Extensions, &c., contemplated; Darlington Co-operative Society.

DARWEN.—Proposed waterworks; Borough Engineer.

DEWSBURY.—Sewage works extension, &c. (about £50,000); Borough Surveyor.

DUBLIN.—New Registry of Titles office, Four Courts, for H.M. Board of Works.

DUNDEE.—Alterations on Ancrum Road School; Clerk, School Board. Alterations on property in High Street and Overgate, for W. Patterson. Alterations on and additions to property, 268-270, Hill Town, for J. Young. Garage, for W. Scott, Perth Road. Warehouses and workshop in South Road and Millar's Lane, for East Bros., Ltd.

DURHAM.—Building scheme in connection with the Blue Coat School; Managers.

ECCLES.—Contemplated new school in Monton and Winton district; Secretary to the Education Committee.

EDLINGTON (near DONCASTER).—Proposed Primitive Methodist Church; Trustees.

ELLESMERE PORT (near BIRKENHEAD).—New Wesleyan Church; A. Brocklehurst, architect, Manchester.

FARNWORTH (near BOLTON).—Proposed new infant school; Rev. A. C. Sinclair, curate-in-charge, All Saints' Church.

FIFE.—Additional hospital accommodation for Fife and Kinross; Gillespie and Scott, architects, St. Andrews.

GARSTON (near LIVERPOOL).—Proposed Sir Alfred Jones Memorial Hospital on Lightbody Estate (£24,500); Executive Committee.

GLOUCESTER.—New factory, Hempsted Lane (negotiations for site carried out by Bruton, Knowles & Co.).

GOLCAR.—Business premises and house, James Street; A. Shaw, architect, Golcar.

GRINGLEY (near GAINSBOROUGH).—Proposed restoration and enlargement of the church (£8,000); Vicar.

HALIFAX.—Proposed new church at Siddal; Vicar of St. Marks.

HASTINGS.—New business premises for laundry, York Road, Silverhill, St. Leonards; Jeffery & Son, architects, Havelock Road, Hastings. Alterations and additions to Hazlebree, St. Saviour's Road, St. Leonards; T. W. Elworthy, architect, London Road, Hastings. Alterations and additions to 14 and 15, Kenilworth Road, St. Leonards; F. G. Hatton, owner, Kenilworth Road. Alterations to 239, London Road, St. Leonards; H. Ward, architect, Bank Buildings, Hastings. Alterations to Assembly Rooms, Sedlescombe Road, St. Leonards; F. Plowman, architect, Havelock Road, Hastings.

HATHERSAGE (near SHEFFIELD).—E.L. installation at Brookfield Manor, for Mr. Dobbs, Ranmoor, Sheffield.

HUDDERSFIELD.—Proposed new Church at Grimscar; Rev. M. Richardson, vicar of St. John's.

HULL.—New school, Sauer Street, for the T.C.; J. H. Hirst, City Architect, Town Hall.

HUTTON (near PRESTON).—New dairy and hostel at the County Council farm (£10,000); H. Littler, County Architect, 16, Ribblesdale Place, Preston.

KILMACOLM.—Church halls for the Parish Church; J. J. Burnet, architect, Glasgow.

KIRKBURTON (near HUDDERSFIELD).—Contemplated parish hall; Rev. Canon Phipps, vicar.

KNOTTINGLEY (near PONTEFRACT).—Contemplated parish room; Rev. J. Hyndson, vicar of Christ Church.

LANCASTER.—Proposed new mission; Pastor, Independent Methodist Mission, Wolsey Street.

LEICESTER.—Rebuilding St. George's Church (£16,200); W. D. Caröe, architect, 3, Great College Street, Westminster, S.W.

LIVERPOOL.—Proposed new elementary school in Barlow's Lane, Fazakerley (900 places); J. G. Legge, Director of Education, Education Offices, St. Thomas Street, Liverpool. New schools, Grosvenor Street, for St. Joseph's Roman Catholic Church; Rev. Father W. Griffiths, rector. Revised scheme for Pierhead Baths (£40,000); City Architect.

LOCKWOOD (near HUDDERSFIELD).—Weaving shed, &c.; Lunn & Kaye, architects, Huddersfield.

LONDON (SHOREDITCH, N.E.).—Dispatch room and stores at Dorset Works, East Road; Proprietors.

(DEPTFORD, S.E.).—Model dwellings (over £11,000); W. J. Burton, builder, St. Peter's Road, Broadstairs.

(ACTON, W.).—Extensions to Acton Sanitary Laundry; W. L. Cook, Stafford Road, South Acton. Eight villa residences, Lynton Road; A. Welford, Lynton Road. Premises at Stanley Gardens, for the Acton Plating Co.

(EALING, W.).—Alterations and extensions at 220 and 222, Uxbridge Road; J. Schofield, 220, Uxbridge Road.

(W.C.).—Laboratory buildings for the University of London (£6,000); Prof. F. M. Simpson, architect, 88, Gower Street, W.C.

LONGFORD.—Contemplated addition to St. Mel's College (£3,000).

MACCLESFIELD.—Renovation scheme at the Infirmary; Clerk to the Infirmary Board.

MEXBOROUGH (near ROTHERHAM).—Proposed Primitive Methodist Church; Trustees.

MORECAMBE.—Proposed additional school accommodation at United Methodist Church, Clarence Street; Rev. M. de J. Lark, pastor.

NAIRN (N.B.).—Extension of the harbour (£17,000); Burgh Surveyor.

NEWPORT (I.W.).—Additions to Fernside, Shide; G. F. Quinton, builder, 1, Carisbrooke Road, Newport.

OSSETT (near DEWSBURY).—Structural alterations at Flushdyke Bethel Independent School; Pastor.

OXFORD.—School (£7,000); A. Castles, City Estate Offices, City Hall, Oxford.

PADGATE (near WARRINGTON).—Contemplated sewage scheme; Clerk to the Poulton-with-Fearnhead P.C.

PADIHAM.—Proposed new church at Hapton; Rev. T. W. Hodson, curate-in-charge. Headquarters for the East Lancs. Territorial Force Association; Secretary, National Buildings, St. Mary's Parsonage, Manchester.

PLYMOUTH.—Alterations to the Workhouse, for the B.G.; Thornely, Rooke and Barron, architects, 11, The Crescent, Plymouth.

PORTADOWN.—Electric theatre, Bridge Street, for Irish Provincial Theatres Co.; P. Cahill, architect, Dundalk.

PRESTON.—Proposed new churches in Deepdale and Frenchwood districts; Rev. C. M. Clarke, Vicar of Christ Church.

PURTON (WILTS.).—New vicarage (over £2,000); the Vicar.

RICHMOND-ON-THAMES.—Extension of music warehouse, Red Lion Street, and houses, Leybourne Park; Brewer, Smith and Brewer, architects, Richmond. Workshops, showrooms, &c., Church Terrace; E. J. Partridge, architect, George Street. Alterations and additions to Brynderwen, Mortlake Road; E. K. Purchase, architect, 20, Maddox Street, W.

ROCHDALE.—Rebuilding portion of Fieldhouse Mills, after fire, for J. Bright and Co.

ROTHWELL (near WAKEFIELD).—Further additions at the National schools (£900); Rev. E. G. W. Benee, vicar.

RUSHALL (near WALSALL).—Proposed infant school in High Heath Road; Secretary to the Staffs. Education Committee.

SEVEN SISTERS (near NEATH).—Vicarage; J. C. Rees, architect, Parade Chambers, Neath.

SHEFFIELD.—Proposed new school for the deaf; G. S. Baxter, Secretary to the Education Committee.

STIRLING (N.B.).—Proposed new station, for the Caledonian Railway; Mr. Mathieson, General Manager. Contemplated refuse destructor; Burgh Surveyor.

STONEHAVEN.—Garage for Davidson & Sons, motor-car dealers, Bervie.

STRETFORD (near MANCHESTER).—Proposed new Roman Catholic school, Trafford Park; Clerk to the Education Committee.

TULLAMORE.—Projected new Town Hall and Technical Institute (£3,600); Mr. M'Namara, architect.

TYNEMOUTH.—Proposed additional school accommodation; Secretary to the Education Committee.

WAKEFIELD.—Proposed church at New Scarbro'; Rev. J. T. Levens, Vicar of St. Paul's.

WALKDEN.—Developments (surface and below) at various collieries; Earl of Ellesmere.

WARRINGTON.—Proposed new Congregational Church in Padgate Lane (£2,500); Pastor, Wickliffe Congregational Church.

WEDNESBURY.—Proposed metallurgical and engineering institute (£12,000); Secretary to the Staffs. Education Committee.

WHALEY BRIDGE (near STOCKPORT).—Proposed outfall works; Mr. Brady, Engineer to the Joint Sewage Board.

WIGAN.—Improvements; Douglas Bank Collieries Co.

WREXHAM.—Extensive alterations to business premises, 5, Henblas Street, for Mr. Elias, clothier.

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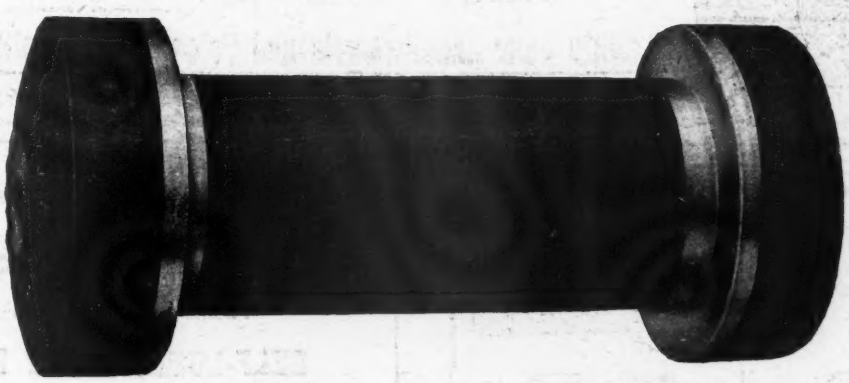

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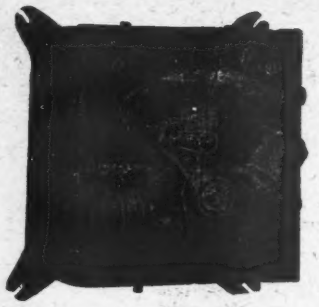

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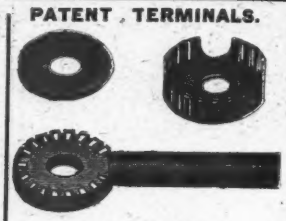

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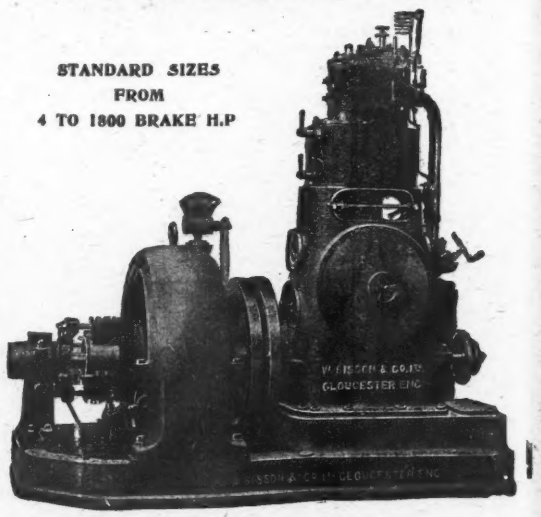

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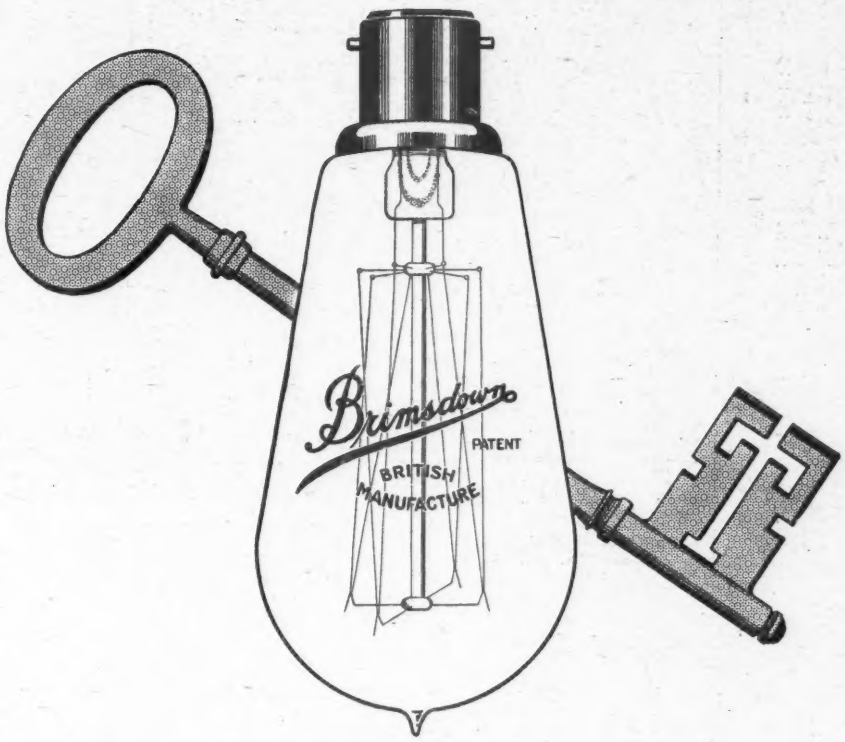

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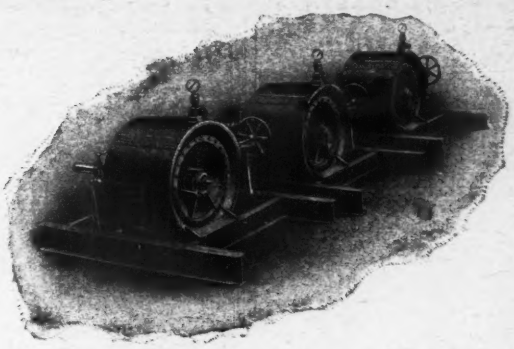

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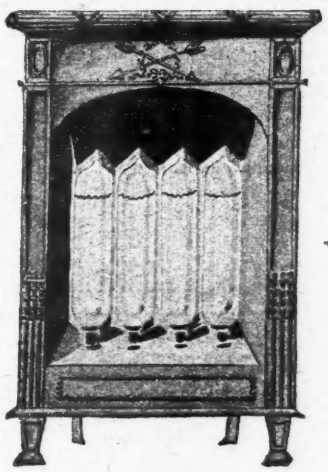

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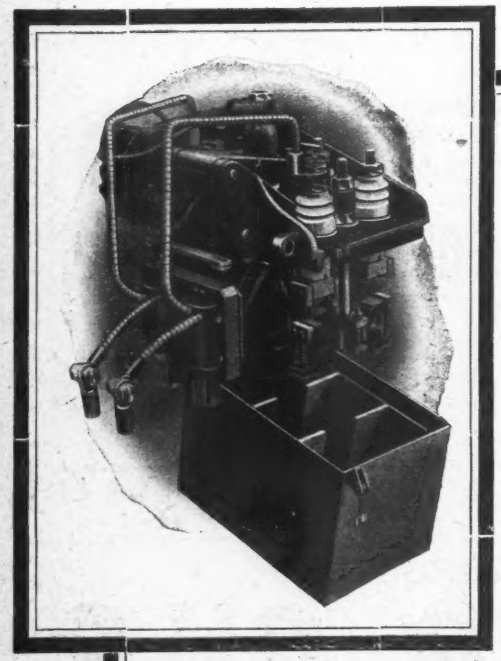

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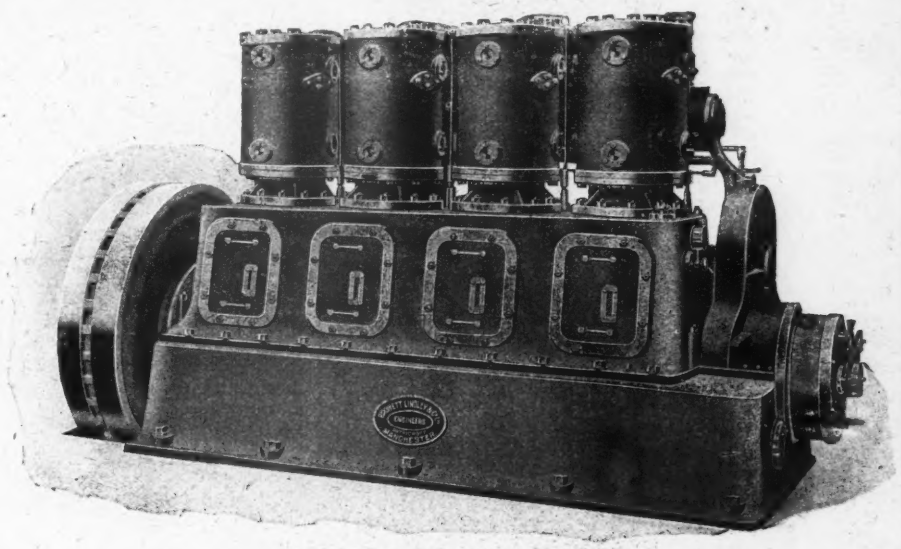

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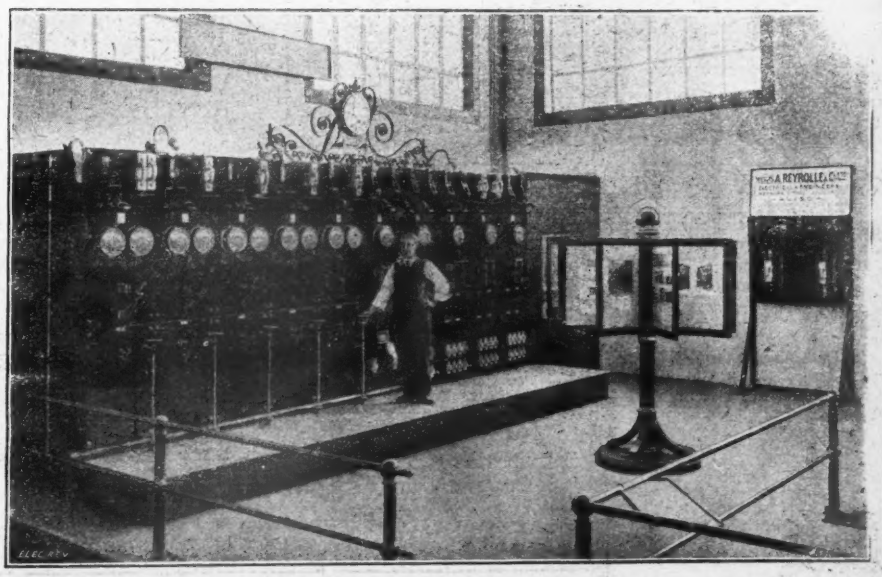

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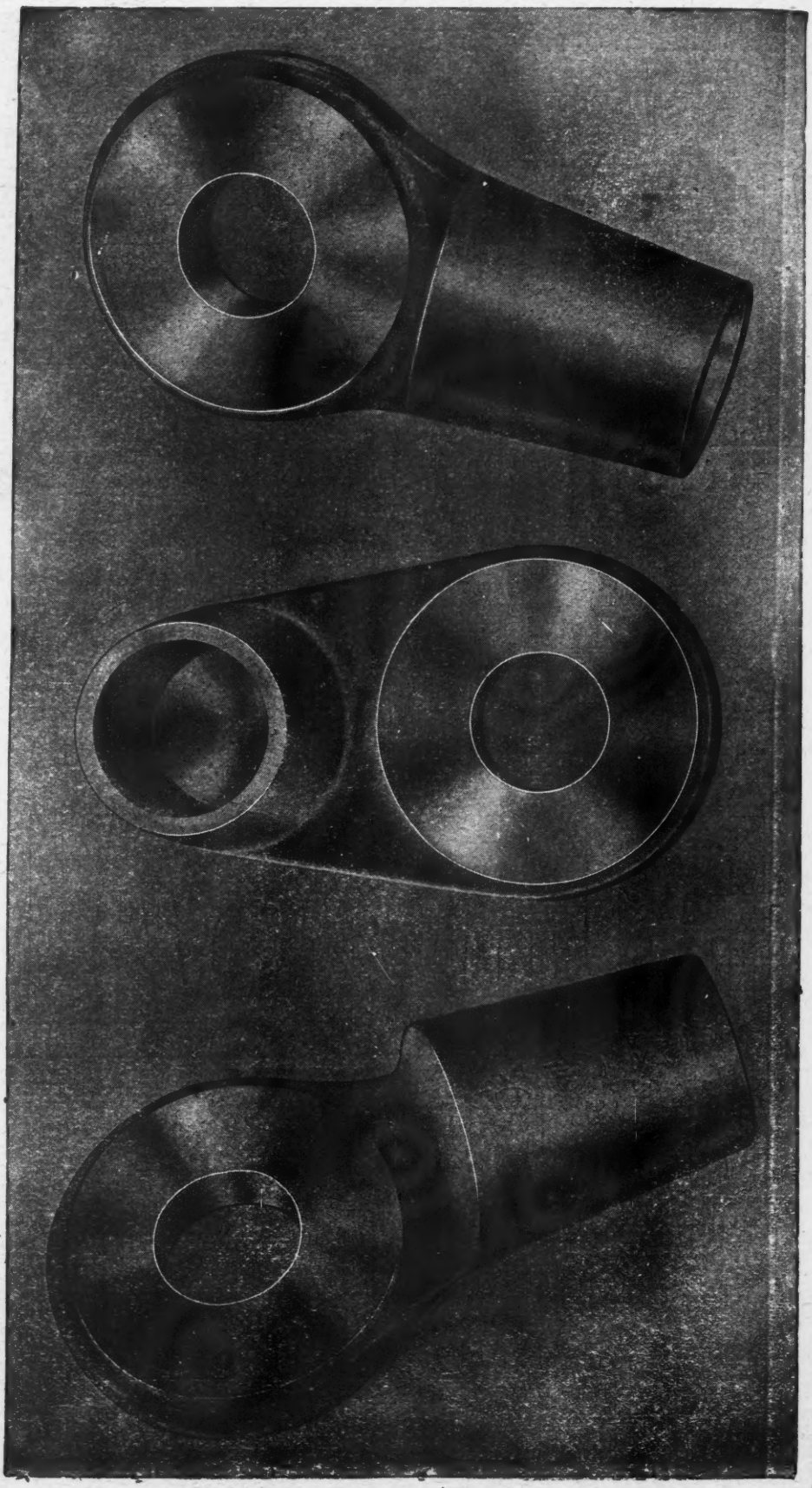

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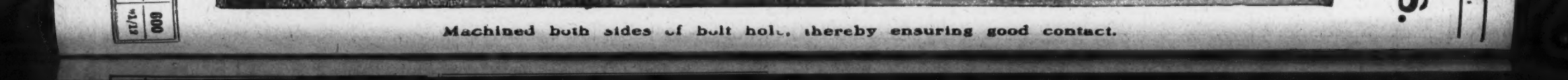

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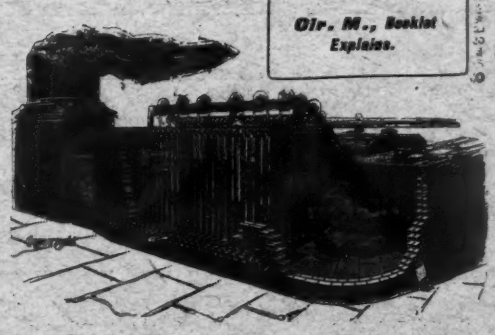

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